The Functions of Portolan Maps: An evaluation of the utility of manuscript nautical cartography from the thirteenth through sixteenth centuries

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Abstract

In the thirteenth century, following the expansion of seafaring city-states and kingdoms in the Mediterranean, a new form of cartography emerged, known as portolan charts. These maps, more secular and scientific than earlier cartographic genres, were produced between the thirteenth and seventeenth centuries, primarily in the western Mediterranean. While portolan charts and atlases have been studied since the nineteenth century, they remain enigmatic. One of the most important questions about them has been: 'what was their function'? Most scholars have argued that they were fundamentally utilitarian maps, used for navigation. This thesis challenges that theory, and proposes that portolan maps were not navigational.

To critically assess the function of portolan maps, the first chapter evaluates their methods of construction, as determined through an analysis of primary sources, and an original archaeological reconstruction of a portolan chart. The second chapter presents seven case studies of charts, atlases, and their makers, to explore the cartographers' output, the specific functions of their maps, and how they relate to the genre as a whole. The third chapter analyses the contemporary documentary and literary evidence to gain a better understanding of the economic market for portolan maps. The fourth chapter evaluates their functions, in two parts: the first discusses how the maps could have been used on ships, how they changed over time, and investigates the practical utility of their toponymy and hydrography. The second part explores their alternative functions, which were as administrative and encyclopaedic maps, spiritual and scholarly maps, and aesthetic objets d'art.

Although some evidence suggests portolan maps were used at sea, it is largely circumstantial and unspecific. The evaluation of their construction, specific functions, the output of cartographers, and their practical utility, instead indicates that portolan maps were not navigationally useful, but embodied number of other purposes.

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List of Abbreviations

BAV	Biblioteca Apostolica Vaticana
BL	British Library
BN	Bibliothèque Nationale de France
BNC	Biblioteca Nazionale Centrale
BRBML	Beinecke Rare Book and Manuscript Library
CUP	Cambridge University Press
HSA	Hispanic Society of America
JCBL	John Carter Brown Library
JFBL	James Ford Bell Library
MC	Museo Correr
NMM	National Maritime Museum (Greenwich)
OUP	Oxford University Press
UCP	University of Chicago Press
YUP	Yale University Press

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Introduction

In the Middle Ages, prior to the twelfth century, most information that today might be represented cartographically was instead written as lists or as dialogue in the form of terriers and itineraries. Except for a few rare examples, when cartography was undertaken in the early Middle Ages, the maps were small and simple diagrams accompanying texts, such as tripartite and zonal diagrams. The later Middle Ages witnessed an increasing interest in geography, resulting in more complex cartography, often exemplified by luxurious world maps such as those from Hereford and Ebstorf. Although they can be considered cartographic representations, they were not maps in a modern sense. Instead, *mappaemundi* were biblical, historical, and anthropological encyclopedias, in which any kind of information – not only geographical – could be arranged spatially.[1] However beautiful and abundant in information, they certainly could not be used to plot a route from one place to another.

In the thirteenth century, following an expansion of commercial seafaring and the development of a new merchant class, a new form of cartography emerged, commonly known today as the 'portolan chart'.[2] Whereas *mappaemundi* had been ecclesiastical in origin, these maps were more secular, and have generally been acknowledged by scholars to be the the first mainstream functional map genre to appear in Western Europe; as early as 1904, Charles Raymond Beazley called them "The First True Maps".[3] The genre flourished for four centuries: the earliest survivor – the *Carte Pisane* – has been dated to c. 1290 (possibly earlier),[4] and portolan maps continued to be made through the end of the seventeenth century. In basic form, portolan maps were manuscript, produced on parchment, and comprised the coastal outlines of the Mediterranean, Black Sea and the

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[1] There was no Latin word meaning 'map'. World maps were called *mappaemundi*, but this is a false cognate and instead literally means 'cloth of the world'. See: Harvey, P. D. A.: *Medieval Maps* (London: BL, 1991). p. 19, and Harvey, P. D. A.: *Mappa Mundi: The Hereford World Map* (Hereford: Hereford Cathedral, 2010). p. 44.

[2] Throughout this thesis, the terms 'portolan chart' and 'portolan map' will both be used to refer to this genre of cartography including both charts and atlases.

[3] Beazley, C. Raymond: 'The First True Maps', *Nature*, 71 (1904), 159-161.

[4] A recent article by Pujades i Bataller has however questioned the early dating of the *Carte Pisane* in light of toponymic research and its relationship with the newly discovered 'Lucca Chart', which has been arguably dated to the fifteenth century. See: Pujades i Bataller, Ramón J.: 'The Pisana Chart: Really a primitive portolan chart made in the 13th Century?', *Comité Français de Cartographie*, 216 (2013), 17-32, and Billion, Philipp: 'A Newly Discovered Chart Fragment from the Lucca Archives, Italy', *Imago Mundi*, 63: 1 (2011), 1-21.

Atlantic coasts. Although varying in particulars, all adhered quite closely to the following characteristics: first, islands, shoals, bays, headlands, and estuaries conformed to certain conventions of colour and symbols; second, these nautical charts also included sixteen (or from the mid-fourteenth century onwards usually thirty-two) equidistant compass points in a large circle with straight lines running between each and beyond to the edge of the parchment. Known as 'rhumb lines' or 'loxodromes', these were lines of constant compass bearing. Third, running perpendicular to the littoral were hundreds and sometimes thousands of toponyms (place-names), comprising ports, other man-made structures and natural markers such rivers or cliffs.

Figure 0.1: The 1505 chart of Jehuda Abenzara, a quite typical decorated portolan map. New Haven: BRBML, 30cea/1505. Image courtesy of the Beinecke Library: <http://brbl-zoom.library.yale.edu/viewer/1015869> [Accessed 3 February 2014].

Although some scholars of cartography have called these charts simply 'portolans', this is an incorrect term which has derived from one of the theories of their origin; 'portolans', from the Italian *portolani*, were written sailing directions comprising lists of sequential place-names around a coastline often including direction and distance. It has been theorised that portolan maps were either designed to accompany these written directions or were derived from them. Various names have been used for the genre: nineteenth-century catalogues from the British Museum list them confusingly as '*portolani*' or 'sea-charts', and C. Raymond Beazley in his 1904 article incorrectly called them '*portolani*'.[5] Gautier Dalché argued that the terms 'portolan chart' or 'nautical map' or any derivation thereof presupposed without evidence that they were based on written portolans, or that they had a nautical function, and instead suggested the using the term '*cartes marines*'.[6] Tony Campbell, after a discussion of various terminologies, chose to call them 'portolan charts' for the sake of convenience.[7] Others have argued for different terms: 'rhumb-charts', 'loxodromic charts', 'compass charts', 'marine charts', and 'nautical charts' have all been employed at one time or another. Contemporaneous documents used variable terminology: *carta* (or *tabula*) *de navigar*, *carta pro navigando*, *carta de marear*, and *mappae maris* were used, but confusingly these nautical charts were also sometimes simply called *mappaemundi*. Considering the most common term used currently in English histories of cartography is 'portolan chart', this or 'portolan map' will be used throughout this text, and will refer to the entire genre including both charts and atlases unless otherwise indicated.

Concerning extant works, Campbell's census determined that approximately 180 portolan charts and atlases have survived dating from the late thirteenth century to 1500, and he posited this must be a small percentage of the total actually produced.[8] Astengo compiled a list of portolan charts and atlases dating from after 1500, and calculated that over 650 maps exist in public collections, and many more in private hands.[9] Richard Pflederer's 2009 census comprised 1842 charts and atlases from c.1290 through the end of the seventeenth century.[10]

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[5] Beazley: (1904), p. 159.

[6] Gautier Dalché, Patrick: 'Cartes marines, représentation du littoral et perception de l'espace au Moyen Âge. Un état de la question', in *Zones côtières littorales dans le monde Méditerranéen au moyen âge: défense, peuplement, mise en valeur. Actes du colloque international organisé par l'Ecole française de Rome et la Casa de Velázquez*: Rome, 1996, Castrum 7. (Ecole française de Rome et la Casa de Velázquez, 2001), pp. 9-32. p. 10.

[7] Campbell, Tony: 'Portolan Charts from the Late Thirteenth Century to 1500', in *The History of Cartography*, ed. by J. B. Harley and David Woodward, 3 vols. (Chicago: UCP, 1987), vol. 1, pp. 371-463. p. 375.

[8] Campbell, Tony: 'Census of Pre-Sixteenth Century Portolan Charts', *Imago Mundi*, 38 (1986), 67-94; ---: (1987), p. 373.

[9] Astengo, Corradino: 'The Renaissance Chart Tradition in the Mediterranean', in *The History of Cartography*, ed. by David Woodward, 3 vols. (Chicago: UCP, 2007), vol. 3, pp. 174-262. p. 177.

[10] Pflederer, Richard: *Census of Portolan Charts and Atlases* (Williamsburg: privately printed, 2009).

Previous Research

Early research on portolan maps generally took the form of either broad empirical surveys or brief studies of individual maps: the former began with Baron Nordenskiöld's 1897 *Periplus*,[11] followed by several empirical and national 'cartobibliographies' such as the sixteen-part *Monumenta cartographica Africae et Aegypti* (1926-51) by Youssouf Kamal, the four-volume *Monumenta cartographica Vaticana* (1944-55) by Roberto Almagià, and the six-volume *Portugalie Monumenta Cartographica* (1960) by Armando Cortesão and Teixeira da Mota. Largely designed to present facsimiles of national cartographic collections, these works rarely ventured beyond descriptions, and when there was in-depth analysis, according to Tony Campbell, the conclusions were often "sweeping generalisations based on a priori reasoning".[12] A survey of early volumes of several journals such as *Imago Mundi* (published since 1935) and *The Geographical Journal* (published since 1893) revealed several articles concerning portolan charts, but most were concerned either with highly specific aspects, e.g. the representation of Scotland or Ireland,[13] or descriptions of then unpublished individual maps.[14] Many articles and monographs have also vaguely referred to portolan charts in a wider discussion of geography or history.[15] While these early studies are certainly useful, they were often myopic and empirical, lacking synthesis and comparative analysis.

Largely credited to the ongoing international *History of Cartography* project began by J. B. Harley and David Woodward in the 1980s, the last decades have seen growing scholarly interest in early maps. Campbell, in his seminal 1987 chapter in the first volume of *The History of Cartography*, having worked primarily with portolan charts in UK libraries and archives, discussed the origins, methods of compilation and drafting, stylistic elements, hydrography, chart-makers, and finally the overall function of the charts from 1290 to

[11] Nordenskiöld, A. E.: *Periplus: An Essay on the Early History of Charts and Sailing-Directions*, trans. by Francis A. Bather (Stockholm: P.A. Norstedt, 1897; repr. New York: Burt Franklin, 1964).

[12] Campbell: (1987), p. 372.

[13] For example: Winter, Heinrich: 'Scotland on the Compass Charts', *Imago Mundi*, 5 (1948), 74-77. p. f. 2v, and Andrews, Michael C.: 'Rathlin Island in the Portolan Charts', *The Journal of the Royal Society of Antiquaries of Ireland*, 15: 1 (1925), 30-35

[14] Examples include: Caraci, Giuseppe: 'An Unknown Nautical Chart of Grazioso Benincasa, 1468', *Imago Mundi*, 7 (1950), 18-31; H., E. (Heawood, Edward): 'An Undescribed Map of Lopo Homem, 1519', *The Geographical Journal*, 76: 2 (1930), 159-160; Uhden, Richard: 'An Unpublished Portolan Chart of the New World, A. D. 1519', *The Geographical Journal*, 91: 1 (1938), 44-50.

[15] For example: Ravenstein, E. G.: 'The Voyages of Diogo Cão and Bartholomeu Dias, 1482-88', *The Geographical Journal*, 16: 6 (1900), 625-655; Prestage, Edgar: *The Portuguese Pioneers* (1933; repr. London: Adam & Charles Black, 1966).

1500.[16] Two decades later (2007), and published in the third volume of the aforesaid *History of Cartography*, Corradino Astengo began where Campbell finished, and examined the later portolan charts from 1492 through the seventeenth century. He discussed the methods of compilation and drafting, with more particular reference to New World discoveries, the correction of magnetic versus true north, the beginnings of latitude, the centres of production, the consumers and patrons of the maps, and the toponymy. In the same year, Ramon Pujades i Bataller, in *Les cartes portolanes: La representació medieval d'una mar solcada*, having worked mostly with maps and archives in Catalonia and the rest of Spain, provided a more culturally-focused inquiry into the relationship between portolan charts and the history of cartography within the different areas of the Mediterranean.[17] He discussed the economic and cultural history of the charts in great detail, and inquired further into the production process, the chart-makers and their clients. In 2009, Pujades i Bataller published *La Carta de Gabriel de Valseca de 1439*, the first major modern work to focus specifically on a single prolific chart-maker, analysing not only his surviving maps but through exhaustive archival study, contemporary documents relating to his business as well.

While the genre of portolan cartography has been studied by a number of scholars, there remains more to be accomplished. The proliferation of technology for digitalisation and archaeometry in recent years could be applied successfully to the scientific and cartometric analysis of these maps. Furthermore, although Pujades published a significant compilation of historical documents pertaining to the ownership and use of portolan charts, the vast majority of archives have remained unexplored for this vital contextual information. Additionally, many early maps, especially nautical charts, have not been sufficiently scrutinised with respect to recent cartographic theories of aesthetics, mimesis, territoriality, subjectivity, bias, and political power. Finally, and more fundamentally, more research is needed with regard to the actual function or functions of portolan maps within the societies which made them.

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[16] Campbell: (1987).

[17] Pujades i Bataller, Ramón J. : *Les cartes portolanes: La representació medieval d'una mar solcada*, trans. by Richard Rees (Barcelona: Institut Cartogràfic de Catalunya, Institut d'Estudis Catalans, Institut Europeu de la Mediterrània, 2007).

Hypothesis

Based on their appearance, it is little wonder portolan maps have largely been regarded as utilitarian; in other words, that their function was for wayfinding. The easily recognisable shape of the Mediterranean coastline of even the earliest surviving charts and atlases, especially in comparison with earlier maps, combined with their obvious hydrographical focus, has led most to immediately conclude that the maps' primary function was for navigation. This thesis seeks to critically evaluate that function, and proposes that, while some portolan maps may have been used for navigation, this was not their sole purpose, and probably not even their primary one. Instead, in the same way *mappaemundi* were created as a compilation of biblical history, anthropology and the *machina universitatis*,[18] the portolan charts were created for numerous non-navigational reasons: to show-off the owner's worldliness, for use by merchants to reference current and potential trade ventures, for scholars to study the geography of the known world, or to assemble and document new discoveries and territories.

The theory that portolan charts were not designed for navigation is contentious. Considerable evidence has been presented arguing the contrary, but the debate is far from concluded. Tony Campbell posited that the "question of function is arguably the most crucial of all."[19] He remarked that there is a distinction to be made between utilitarian navigational maps for which documentary evidence exists, and other examples "constructed with the pleasure and enlightenment of landsmen in mind," but admitted there is no evidence for any navigational use-wear markings on any known surviving chart.[20] However, Campbell maintained that the primary function of the maps were as navigational aides, and that it is due to the nature of survival that utilitarian charts have not survived. The archival work of Pujades i Bataller led him to the conclusion that portolans, beginning with their inception in the early thirteenth century, quickly became numerous and necessary for navigation until well into the sixteenth century, and possibly later. In his influential 2007 opus *Les Cartes Portolanes*, he thoroughly detailed documentary evidence for

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[18] Morse, Victoria: 'The Role of Maps in Later Medieval Society: Twelfth to Fourteenth Century', in *The History of Cartography*, ed. by David Woodward, 3 vols. (Chicago: UCP, 2007), vol. 3, pp. 25-52. pp. 31-32.

[19] Campbell: (1987), p. 438.

[20] Ibid. pp. 440-443. Campbell noted that holes from divider compasses are sometimes seen in scale bars and intersection points, but it was more likely these were a result of the drafting process and not from navigational use.

the existence of nautical charts and atlases from 1200 to 1470, and his conclusion was that nautical charts were vital and commonplace instruments for navigation.[21]

A number of various methodologies have been used in the history of cartography to great effect; because maps are multivariate objects, it was decided that an interdisciplinary approach would be best to make an evaluation of portolan maps, their function, and their use. Accordingly, this thesis will employ a range of approaches through an archaeological reconstruction, empirical cartographic analysis, and contextual history to assess their functions.

The first chapter seeks to understand how portolan maps were made, and consists of an archaeological reconstruction of a portolan chart with a historical discussion of production processes. The aims of the chapter are to reach a better understanding of how easily and quickly the maps were produced, to what extent they were compiled from original information or copied from earlier maps, and whether it could be surmised that other nautical charts, different to the surviving collection, might have been made for navigation at sea.

The second chapter will present seven in-depth case studies of portolan charts and atlases considered representative of the genre, dating from the early fourteenth through mid-sixteenth centuries.[22] The criteria for choosing the case-studies were: first, their accessibility for examination, either in person or using a high-quality facsimile; second, that they represented a range of different chart-makers working in different places at different times; third, that they displayed a range of different levels of decoration; and fourth, that for many there is information about their provenance and early ownership. For each of the case studies, the examination will discuss the history of the chart-maker, his predecessors and successors, the hydrography, toponymy, and the history of the map. More importantly, each case study will assess what the function of that particular map was, and how similar or different that might have been to other maps.

Having established a deeper understanding of how the maps were produced and what information individual maps included, the third chapter will discuss the contemporaneous literature and documents which noted the existence or use of portolan maps. The intention is to determine who owned portolan maps, how much they cost, and

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[21] Pujades i Bataller: (2007), pp. 428-439, 452-466, 521.

[22] It is not within the scope of this thesis to examine a large number of maps, because a greater number of cursory analyses would risk missing key information that might indicate their utility.

how they were used. Although the use of contemporaneous documents is fraught with limitations, by exploring the economics of the portolan chart trade, a more thorough assessment of their function can be made. Much of the evidence discussed within the third chapter has largely been utilised to prove the theory that portolan maps were used for navigation;[23] from only cursory inspection of their visual appearance, coupled with an examination of the archival evidence, it is unsurprising that many scholars have theorised their navigational primacy.

However, the first part of the fourth chapter will endeavour to explore the functions of the genre of portolan cartography on a practical level, which will be seen to contradict the presumptive conclusions based on the archival evidence. This will be accomplished through an assessment of the process of navigation in the Mediterranean and in the oceans between the thirteenth and eighteenth centuries, and the two utilitarian aspects of portolan maps: toponymy and its change over time, and the hydrography, including its evolution, accuracy, and whether or not the depictions of the coastlines were adequate for use in navigation. The second part of the chapter will briefly explore the alternative functions of the maps as aesthetic, didactic, political, scholarly, or documentary works, to show that these functions are equally if not even more applicable to the genre than navigational utility.

Before the main body of this thesis can be approached however, three aspects must be discussed in order to establish a context for this research. First, a brief survey of the context in which portolan maps were created will provide a historical framework for better understanding of the genre. Second, an evaluation of typology and evolution of portolan maps will be discussed to continue that framework through the lifetime of the genre. Third, a presentation of the arguments other scholars have made both for and against the navigational utility of charts will provide the theoretical framework necessary to argue the hypothesis that portolan maps were not utilitarian.

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[23] Pujades in particular used archival sources to reinforce his conclusions: Ibid.

Historic and Cartographic Precedents

A number of scholars have written extensively on the general history of medieval cartography, including Tooley, Crone, Bagrow, Harvey, Wilford, and Buisseret.[24] Furthermore, a number of books, and articles published in *Imago Mundi, The Geographical Journal*, *Cartographica*, and others, have examined particular genres of cartography, whether mappaemundi, regional maps, local maps or portolan charts. The seminal first volume of the *History of Cartography* series notably published several thorough surveys and analyses of particular types of early maps.[25] For the purposes of brevity, it is unnecessary to reiterate the general history of cartography in this thesis. However, a brief discussion of the origin of portolan charts and atlases, and their general typology will provide a firm basis for the first chapter to discuss the construction of a portolan map.

Medieval Cartography

The making of maps was less common in the medieval world than it had been in the classical, but it did not cease entirely. Because cartography is a highly literate form of communication, it is unsurprising that the earliest forms of map-making in the Middle Ages were ecclesiastical in nature, the clergy being amongst the most well-educated at the time. The same is true for Islamic maps: most were associated with scholars of the Koran. Peter Whitfield proposed reasons for the Christian and Islamic religious interest in geography: the former arose from the fact that most Christian biblical locations were paradoxically outside Christian Europe and often parts of territories controlled by non-believers; the latter both because of the required pilgrimage to Mecca and the sacred direction of prayer known as the Qibla.[26] His hypothesis is reasonable: whereas Christian cartography focused heavily on biblical places and events but did not find exact geographic coordinates altogether necessary, Islamic cartographers, aided by their knowledge of Ptolemy's coordinate system, did focus on direction and location which were important for pilgrimage and the Qibla.

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[24] Tooley, R. V. : *Maps and Map-Makers*, rev. edn. (London: B. T. Batsford Ltd., 1970); Crone, G. R.: *Maps and Their Makers: An Introduction to the History of Cartography* (London: Hutchinson's University Library, 1953); Bagrow, Leo: *History of Cartography*, trans. by D. L. Paisley, ed. by R. A. Skelton, 2nd edn. (London: C. A. Watts, 1964; repr. Chicago: Precedent, 1985); Harvey: (1991); Wilford, John Noble: *The Mapmakers: The Story of Cartography - From Antiquity to the Space Age*, revised edn. (New York: Alfred A. Knopf, 1981; repr. London: Pimlico, 2002); Buisseret, David: *The Mapmakers' Quest: Depicting New Worlds in Renaissance Europe* (Oxford: OUP, 2003).

[25] Harley, J. B. et al. (eds.): The History of Cartography, 3 vols. (Chicago: UCP, 1987), vol. 1.

[26] Whitfield, Peter: *New Found Lands: Maps in the History of Exploration* (London: BL, 1998). pp. 11-13, 19.

The early Christian church faced the task of establishing a universal and unquestionable cosmology. Many church fathers accepted the Aristotelean spherical earth, and most early world maps took circular form as a result.[27] The most common type of maps were known as tripartite or 'T-O' maps, which showed the three known continents to varying levels of detail, from simple diagrams, to large *mappaemundi* like those from Hereford and Ebstorf.[28] While the form of these diagrams originated in the classical period, it spread through Europe via their inclusion in the popular seventh-century texts *Etymologiae* and *De Natura Rerum* by Isidore of Seville. Only with the discovery of the new world did tripartite maps cease to be used.

However, cartography did not develop everywhere in Europe. The great explorers of the early Middle Ages, the Vikings, did not create visual maps, but instead wrote a number of geographically-focused sagas, as well as maritime lists of settlements, sailing directions, and other useful nautical information, known as *periploi* or *portolani*. These written sailing directions were not cartographic, and there is no evidence of any medieval Norse geographic information being presented cartographically.[29] In other parts of medieval western Europe, cartography did develop for numerous reasons, including: the need for the church to establish an enduring cosmological construct; a sense of biblical geography fueled by the holiest places no longer being within the Catholic reach; the Carolingian (and much later Renaissance) interest in classical science and ideas; and fierce competition between individual states within what was, in comparison with Africa and Asia, a small isolated continent, in addition to warfare with hostile and powerful forces from elsewhere in the world. Western Europe could not afford to be introspective, and this fueled a scholarly interest in geography and cosmology.

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[27] A well-cited exception is that of Cosmas Indicopleustes. A well-travelled sixth-century merchant and (later) monk in the Byzantine empire, he wrote a (briefly) popular book entitled *Topographia Christiana*, in which he advocated the concept of a flat disk-shaped earth surrounded by an ocean. It is a modern misconception that all medieval people thought the world was flat; Cosmas' idea of a flat earth was not well-received amongst his learned contemporaries and later scholars. See: Bagrow: (1985), pp. 41-42, and Edson, Evelyn: *Mapping Time and Space: How Medieval Mapmakers Viewed Their World* (London: BL, 1997). pp. 145-149.

[28] A second type, attributed to the second-century BC philosopher Crates of Mallus, were climatic zonal maps which depicted the spherical earth at the equator with the north and south poles at the top and bottom, divided into five zones: two frigid, two habitable and one impassable torrid zone at the equator.

[29] Although it has been suggested the 'Vinland Map' is a representation of Norse cartography, the authenticity of the document has been and continues to be fiercely debated. See: Skelton, R. A. et al.: *The Vinland Map and the Tartar Relation* (New Haven: YUP, 1965; repr. New Haven: YUP, 1995); Larsen, René et al.: 'Facts and Myths about the Vinland Map and its Context', *Zeitschrift für Kunsttechnologie und Konservierung*, 23: 2 (2009), 196-205.

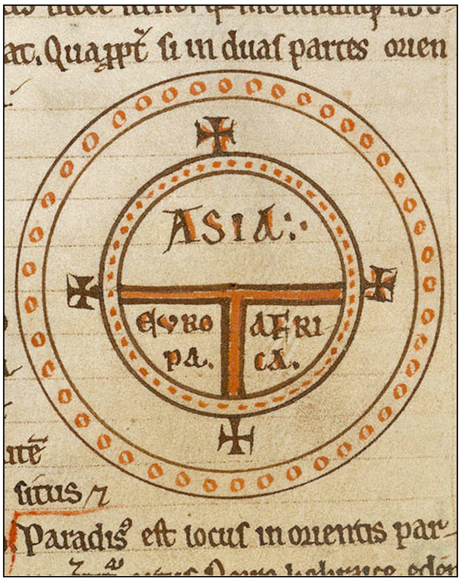

Figure 0.2: A T-O diagrammatic map from a twelfth-century copy of Isadore's *Etymologiae*. London: BL, Royal 12 F. IV (f.135v). Image from: <http://en.wikipedia.org/wiki/File:Diagrammatic_T-O_world_map_-_12th_century.jpg> [Accessed 5 February 2014].

Figure 0.3: The Hereford Mappaemundi, made in the late thirteenth century, and currently at Hereford Cathedral. Image from: <http://commons.wikimedia.org/wiki/File:Hereford_Mappa_Mundi.jpg> [Accessed 5 February 2014].

Nevertheless, cartography during the Middle Ages was a rare intellectual pursuit. Confined primarily to scholars and the church, medieval maps served specific purposes. Natalia Lozovsky discussed three primary functions for medieval cartography: as educational tools, contemplative instruments, and ideological expressions, which must be understood in the context of the time.[30] Additionally, there was no medieval Latin word meaning 'map'. The two most common words were *carta*, which meant 'document' and was also used to describe numerous non-cartographical texts, and *mappa*, which meant 'cloth'.[31] Other less common words used to describe a map included *descriptio*, *figura*, and *pictura*, but they were also rather vague and inexact terms.[32] Thus, although some of medieval Europe engaged in the process of cartography, there was not yet an established sense of what a

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[30] Lozovsky, Natalia: 'Geography and Ethnography in Medieval Europe: Classical Traditions and Contemporary Concerns', in *Geography and Ethnography: Perceptions of the World in Pre-Modern Societies*, ed. by Kurt A. Raaflaub and Richard J. A. Talbert (Chichester: Wiley-Blackwell, 2010), pp. 311-329. p. 312.

[31] It has been surmised that *mappa* was used because some maps were painted on cloth. Harvey: (1991), p. 19.

[32] Edson: (1997), p. 2.

‘map’ was. At the end of the thirteenth century however, a completely new type of cartography enigmatically appeared in a largely secular context and in an almost complete form: the portolan chart.

Historical Precedents

The origin of the portolan chart was undoubtedly linked with the rise of western European maritime activity in the Mediterranean Sea. The proliferation in commercial and military seafaring primarily developed as a result of political and economic growth within various Mediterranean city-states and kingdoms, the competition for dominance between them, and the more universal conflict between western European Christianity, eastern Orthodoxy, and Islamic Asia and Africa.[33]

Despite the rapid expansion of Islam into the Mediterranean in the seventh and eighth centuries, several city-states continued to trade with the East: documents indicate tenth-century trade between Amalfi and Egypt, soon joined by Venice, Lucca, Gaeta, Salerno, Genoa, and Pisa.[34] Victories against the Muslim strongholds in the Mediterranean in the tenth and eleventh centuries both secured new territories and opened up lucrative trade opportunities. The Byzantine reconquest of Crete in 961 and Cyprus in 965 brought those islands back into the empire, with which Venice had been trading since the ninth century. An alliance between Genoa and Pisa conquered Corsica and Sardinia from the Muslims in 1015-16, and in the late eleventh century Genoa was able to secure commercial privileges in several African ports after sacking them.[35] The Norman conquest of Sicily from the Muslims, and Calabria and Apulia from the Byzantines, established the Norman Kingdom of Sicily with Papal backing,[36] resulting in a number of new trading entrepôts

[33] The maritime development of various city-states and kingdoms in the Mediterranean has been discussed by: Lewis, Archibald R. et al.: *European Naval and Maritime History, 300-1500* (Bloomington: Indiana University Press, 1985). pp. 62-85; Scammell, G. V.: *The First Imperial Age: European Overseas Expansion c. 1400-1715* (Abingdon: Routledge, 1989). pp. 86-220; Abulafia, David: *The Western Mediterranean Kingdoms, 1250-1500: The Struggle for Dominion*, ed. by David Bates (Harlow, Essex: Longman, 1997); Busch, Silvia Orvietani: *Medieval Mediterranean Ports: The Catalan and Tuscan Coasts, 1100-1235* (Boston: Brill, 2001); Blockmans, Wim et al.: *Introduction to Medieval Europe, 300-1550*, trans. by Isola van den Hoven (Abingdon: Routledge, 2007). pp. 186-214.

[34] Pujades i Bataller: (2007), p. 414.

[35] Scammell, G. V.: *The World Encompassed: The first European maritime empires c. 800-1650* (London: Methuen, 1981). p. 157.

[36] This is discussed in greater detail in: Previté-Orton, C. W.: *The Shorter Cambridge Medieval History: Volume I, the Later Roman Empire to the Twelfth Century*, 2 vols. (Cambridge: CUP, 1952), vol. 1. pp. 507-513.

and a kingdom incorporating both Byzantine and Arab institutions.[37] Abulafia posited that the conquest of the Balearic islands by James I of Aragon in 1229-31 strengthened political and economic ties with southern France and enabled a growth in Provençal, French and Catalan trade.[38] The first crusade at the end of the eleventh century brought many lucrative opportunities for trade with the East to Genoa, Pisa, and Venice.[39]

There was a significant amount of competition between city-states over the burgeoning maritime opportunities. Amalfi, which had enjoyed trade with Muslim ports since the ninth-century, was significantly weakened by the Norman conquest, and Pisa – their primary rival – was able to destroy them through a series of invasions in the 1130s.[40] Pisa's triumph did not last however: highly competitive with Genoa not only in the Western Mediterranean but in the crusader states, after a series of battles, the Pisan fleet was defeated by the Genoese in 1284 at the battle of Meloria, from which Pisa never recovered.[41] Since the ninth century, Venice had established itself as a dominant naval power in the Adriatic, secured by a victory over the Normans in 1081, and bolstered by commercial trade with the Byzantine empire.[42] A series of successful conflicts against the Muslims in Syria in the twelfth century led to significant trade concessions, and in 1204, Venice conquered Constantinople, gaining a monopoly over trade in the Black Sea.[43]

Given the geographically-eastern focus of the early portolan charts, Pujades i Bataller stressed the importance of Constantinople. Until the Venetian conquest in 1204, no foreign ships had access to the Black Sea, but from 1204 to 1261, the Venetians enjoyed a virtual monopoly on eastern trade.[44] However, the recapture of the city in 1261 by the Nicaean emperor Michael VIII Palaiologos, reversed the fortunes of Venice, and Genoa instead secured trading privileges in the Black Sea for its assistance, and founded numerous

[37] Blockmans et al.: (2007), p. 186.

[38] Abulafia: (1997), pp. 37-41. Pujades noted however, that as a result of being war-torn for decades prior to their conquest, the Balearics under Muslim rule were no considerable threat to Christian maritime trade. See: Pujades i Bataller: (2007), p. 415.

[39] Blockmans et al.: (2007), p. 192. For more about Genoese benefits, see: Epstein, Steven A.: *Genoa & the Genoese* (Chapel Hill, NC: University of North Carolina Press, 1996). pp. 28-32.

[40] Kleinhenz, Christopher (ed.): *Medieval Italy: An Encyclopedia* (London: Routledge, 2004). p. 52.

[41] Epstein: (1996), p. 159.

[42] Scammell: (1981), pp. 89-91.

[43] Ibid. p. 92.

[44] Pujades i Bataller: (2007), p. 414.

colonies that flourished until the fifteenth century.[45] Thus, by the time of the first surviving portolan chart – the *Carte Pisane*, dated to the end of the thirteenth century – a vast network of intense maritime trade was being conducted by numerous kingdoms and city-states, with a lass of wealthy merchants who were managing this explosion of commercialism. In combination with technological advances such as the compass and new types of ships, the environment had been established within which the portolan chart would be invented.

Pujades stressed the additional necessity of both Latin and vernacular literacy amongst the users of portolan maps. He posited that the publication of Leonardo Fibonacci's *Liber Abaci* in 1202, which revolutionised arithmetic through the introduction of Arabic numerals and the decimal point, was necessary for the inception of the portolan chart.[46] By the mid-thirteenth century, the average merchant in a northern Italian city-state would have been literate in the vernacular, have an acceptable knowledge of Latin, would have mastered arithmetic at an abacus school, and would have apprenticed to one or more merchants.[47] These literate professionals would have been an elite and wealthy minority, centered in urban environments; they were not only interested in, but were sometimes even the producers of, the newly-developed nautical maps. Pujades i Bataller noted: "[The] possession of such a valuable instrument of written culture as a nautical chart... would have been practically useless in the hands of an illiterate."[48]

Theories of Origin

There is disagreement amongst scholars as to how and when the entire Mediterranean was initially mapped. There is some evidence that the groundwork for what would become these nautical maps originated with the second-century AD Greek scholar Marinus of Tyre. Known via Ptolemy's *Geographia*, Marinus' contribution to cartographic projection is mentioned, and a few scholars have argued that he is responsible for creating a nautical chart, including Laguarda Trías.[49] However, Tony Campbell demonstrated that

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[45] For a discussion of the Genoese Black Sea colonies, see the Albinus de Canepa case study in Chapter II.

[46] Ibid. pp. 417-418.

[47] Ibid. p. 418.

[48] Ibid. p. 419.

[49] Laguarda Trías, Rolando A.: *Estudios de cartologia* (Madrid, 1981). pp. 29-41, as cited in: Campbell: (1987), p. 381.

the theory rested with a single word – *pinax* – which did not mean 'chart', but simply 'map'.[50]

The *Carte Pisane*[51] is generally accepted as the earliest surviving example of a portolan chart. Although in poor condition, the map was not a precursor or prototype, but is already a well-structured example of the genre, certainly in its depiction of the Mediterranean. The enigma of the sudden appearance of such a map has drawn a few wildly implausible theories. For example, Charles Hapgood argued for an ancient origin, originating in the Neolithic.[52] There was even a suggestion of a several-thousand-year-old map which showed the Antarctic landmass free from ice.[53] However, these pseudo-scientific theories have little academic merit.

Figure 0.4: The anonymous *Carte Pisane* from c.1290. Paris: BN, Rés. Ge. B 1118. Image from: <http://commons.wikimedia.org/wiki/File:Carte_Pisane_Portolan.jpg> [Accessed 5 February 2014].

Far more likely is a medieval origin, and several scholars have suggested that nautical maps were created to accompany the written portolans.[54] Patrick Gautier Dalché brought to the attention of scholars the *Liber de existencia riveriarum et forma maris nostri Mediterranei*, a

[50] Ibid. (note 86).

[51] Paris: Bibliotheque Nationale (Rés. Ge. B 1118). Unlike its name suggests, the map's provenance is regarded as Genoese. As noted above, Pujades argued that the *Carte Pisane* may actually date to the fifteenth century: Pujades i Bataller: (2013).

[52] Hapgood, Charles H.: *Maps of the Ancient Sea Kings: Evidence of Advanced Civilization in the Ice Age*, rev. ed. (New York: E. P. Dutton, 1979) as cited in: Campbell: (1987), p. 380.

[53] Lear, John: 'He Thinks the Earth's Crust is Sliding', *The New Scientist*, 22 May 1958, p. 22.

[54] For example: Nordenskiöld: (1964), pp. 45-50 ; Freiesleben, H. C.: 'The Still Undiscovered Origin of the Portolan Charts', *Journal of Navigation*, 36: 1 (1983), 124-129. p. 125.

geographic treatise which combined a written portolan with some inland geographic and religious information, and supposedly included a map, which is now lost.[55] Gautier Dalché posited the text, which is anonymous and undated, was made in Pisa at the end of the twelfth or beginning of the thirteenth century, though Pujades argued the date was likely after 1204 when western Europe gained access to the Black Sea.[56] Pujades noted the prologue of the *Liber de existencia riveriarum* indicated that the spatial compilation of distance and direction to create a map of the Mediterranean Sea had already been envisaged.[57] The evidence gleaned from the *Liber de existencia riveriarum*, combined with the Italian toponymy which dominated the earliest portolan charts, the earliest reference to a chart on a ship in the *Gesta Sancti Ludovici* from c.1270, and the earliest cartographers being Genoese, led Pujades to the conclusion that the epicentre of the invention of the portolan map was somewhere between Genoa and Pisa in the early to mid-thirteenth century.[58]

Regarding their compilation, David Woodward and Tony Campbell suggested that several smaller regional charts of individual basins were brought together onto a larger map.[59] There have also been theories that the charts were created using the information within the written portolans; a 1987 cartographic study by Lanman was able to confirm this as a possibility.[60] Kelley however, argued that the information contained in many portolani was derived from the charts and not vice-versa.[61] Pelham discussed the possible process of resection and intersection of distance and direction from a ship traveling along a coastline and sighting landmarks could be used to create a map of the hydrography.[62]

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[55] Gautier Dalché, Patrick: *Carte Marine et Portulan au XIIe Siècle: Le Liber de existencia riveriarum et forma maris nostri mediterranei (Pise, circa 1200)*, Collection de L'École Française de Rome, 203 (Rome: École Française de Rome, Palais Farnèse, 1995).

[56] Pujades i Bataller: (2007), p. 511.

[57] Ibid. pp. 512-513.

[58] Ibid. p. 515.

[59] Campbell: (1987), p. 388. Campbell noted that much of the section regarding this was written by David Woodward.

[60] Lanman, Jonathan T.: *On the Origin of Portolan Charts*, The Hermon Dunlap Center for the History of Cartography, Occasional Publication, No. 2 (Chicago: The Newberry Library, 1987). p. 49.

[61] Kelley Jr., James E.: 'Perspectives on the Origins and Uses of the Portolan Charts', *Cartographica*, 32: 3 (1995), 1-16. pp. 9-10.

[62] Pelham, Peter Thomas: 'The Portolan Charts: Their construction and use in the light of contemporary techniques of marine survey and navigation' (Unpublished MA Thesis, Victoria University of Manchester, 1980). pp. 104-105.

Pujades argued that any type of surveying in this manner required a key instrument: the compass.[63]

A more detailed history of the compass is discussed in Chapter V, but the earliest western European description of a compass is generally considered to have been written by Alexander Neckham in his *De Utensilibus* from c. 1190.[64] The importance of the compass to the inception of the portolan maps has been the subject of heated debate: Pujades argued strongly for the importance of the compass in relation to the charts, as did Crone and Taylor.[65] Nordenskiöld argued that the primitive compass would not have been all that useful at sea, and navigators would have opted to use the position of the sun and stars.[66] Lane argued that it was only in the last decades of the thirteenth century that the compass became useful for navigation at sea, which corresponded to the improvement of nautical cartography between the *Carte Pisane* and the maps of Petrus Vesconte.[67] By extension, if the initial survey had occurred at the beginning of the thirteenth century, the compass might not have been a factor. Campbell noted that until a full-scale cartometric study was undertaken to determine local magnetic distortions, the influence of the compass will still be debatable.[68]

Typology and Evolution of the Genre

It would be a mistake to imagine that the genres of medieval and early modern cartography were disparate and could be evaluated independently, and certainly there was variation within each genre. Already discussed was the separation of the genre of portolan charts into two categories: aesthetic maps and utilitarian maps, the validity of which will be assessed later within this thesis, primarily in Chapters II and IV. Naturally, one might also divide the maps into charts and atlases, and imagine a different function and evolution for

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[63] Pujades i Bataller: (2007), pp. 510-511 ; Pujades i Bataller, Ramón J.: *La Carta de Gabriel de Valseca de 1439*, trans. by Catalina Gironda Arguimbau (Barcelona: Lumen Artis Ediciones, 2009). p. 294.

[64] Taylor, E. G. R.: *The Haven-Finding Art: A History of Navigation from Odysseus to Captain Cook* (London: Hollis & Carter, 1956). p. 95.

[65] Pujades i Bataller: (2007), pp. 510-511; Pujades i Bataller: (2009), p. 294; Crone: (1953), p. 34; Taylor: (1956), p. 99.

[66] Nordenskiöld: (1964), p. 47.

[67] Lane, Frederic C.: 'The Economic Meaning of the Invention of the Compass', *American Historical Review*, 68: 3 (1963), 605-617. p. 616.

[68] Campbell: (1987), p. 385.

each, but as will be seen in Chapter II, atlases and charts were not dissimilar except in their layout: their hydrography and toponymy were often virtually identical.

Pujades recommended that portolan charts be divided into five categories: transitional *mappaemundi*, in which the traditionally-mapped area of portolan charts are incorporated into world maps; complete charts, which include the entire Mediterranean and Black Sea; partial charts, which focus either on the eastern or western halves of the Mediterranean; Atlantic charts, which focus only on the Atlantic; and Adriatic charts, which focus only on that sea.[69] His study however, only examined maps from c.1290 to 1470, and thus did not take into account the hybrid portolan charts that appeared in the sixteenth century, with a smaller scale that allowed the entire African Atlantic and New World coastlines to be incorporated onto a single parchment. Additionally, his typology only took the hydrographic coverage into account, separating partial charts of only the eastern or western Mediterranean from charts of the entire sea, when their hydrography, toponymy, and scale would have been nearly identical. Instead of categorisation, it might be more useful to consider each portolan map as falling upon a spectrum, of which one axis is their extent of decoration, and the other axis is their scale.

Figure 0.5 shows the plotting of scale along the x-axis, and the amount of decoration and extraneous information along the y-axis. The maps of the smallest scale were those that attempted to depict the entire world on a single parchment, such as *mappaemundi*, whereas those as the largest scale depicted only a small area. As will be discussed in the following chapters, nearly all portolan charts and atlases in the fourteenth and fifteenth centuries were drawn at a similar scale: between 0.9 cm : 50 portolan miles (known as 'miglia'), and 1.2 cm : 50 miles.[70] A small number of rare regional maps were drawn at a larger scale, one of which was the 1567 chart by Jacopo Maggiolo, the seventh case study in Chapter III. The other axis plots the amount of decoration; in general, Catalan maps were more decorated and sometimes included a significant amount of information derived from mappaemundi. Genoese maps did as well, though there were some with only minor

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[69] Pujades i Bataller: (2007), p. 424.

[70] This information was largely drawn from cartometric information provided in: Ibid. pp. 204-209.

decoration. Early Venetian maps tended to be without ornamentation, but not always: in the sixteenth and seventeenth centuries they became more elaborate. Indeed, if it were possible to show the diagram evolve over time, the map groupings would move more towards the decorative end of the spectrum as there exist few surviving late examples of portolan maps that are without a significant amount of decoration.

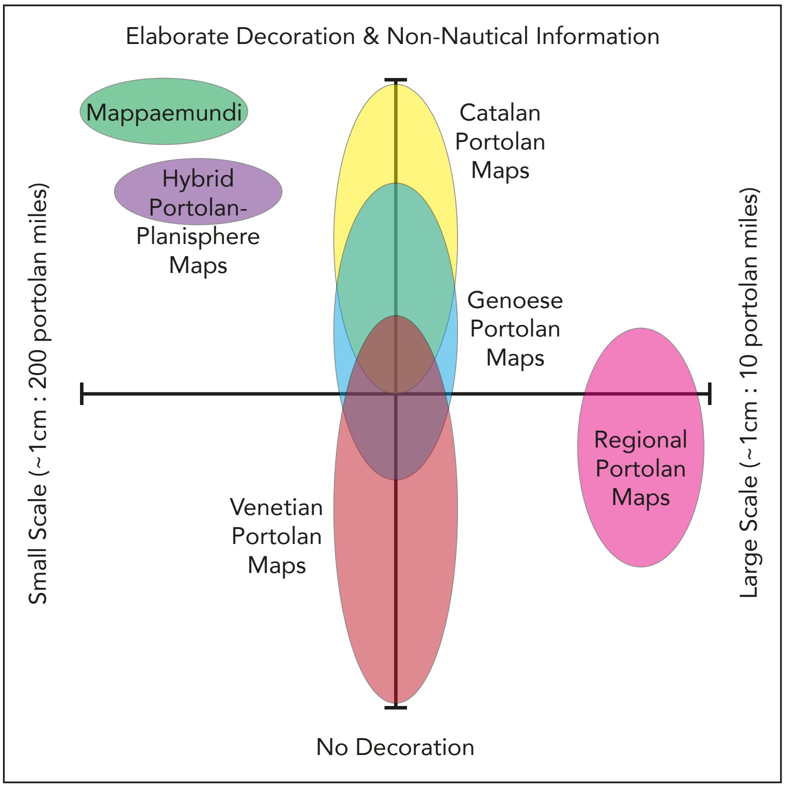

Figure 0.5: Portolan map spectrum, whereby maps can be plotted according to their extent of decoration and their scale.

The genre of portolan maps changed over the four centuries of its lifetime. Between the late thirteenth century and 1320, the maps appear to have been improved significantly in terms of their toponymy and hydrography, and this might be considered a formative period. After the influential cartographic works of Petrus Vesconte and Angelino Dulceti in the 1320s and 30s however, the maps did not change significantly in form, but slowly began to focus less on the east, and more on the west and the Atlantic, gradually incorporating newly-discovered island archipelagoes and the African coastline as it was explored by the Portuguese. These toponymic and hydrographic changes are discussed in further detail in Chapter IV.

Several changes occurred at the beginning of the sixteenth century. The focus on the Atlantic discoveries culminated in the mapping of the New World coastlines, and measured latitude scales appeared for the first time on the maps. A new sub-genre was the result, the hybrid portolan-planisphere, which as noted earlier, sacrificed scale to incorporate more of the mapped world onto a single parchment. One of the earliest examples of this hybrid portolan chart is the Juan de la Cosa map from 1500, shown in Figure 0.6. Although it was a map of the entire known world, it nevertheless included rhumb lines, toponyms perpendicular to the coastline, and the typical portolan hydrography, albeit smaller than

Figure 0.6: The Juan de la Cosa chart, made in Puerto de Santa Maria in 1500, depicting the entire world as it was known, but still featuring many hallmarks of portolan charts. Madrid: Museo Naval. Image from: <http://en.wikipedia.org/wiki/File:1500_map_by_Juan_de_la_Cosa_rotated.jpg> [Accessed 11 October 2013].

normal. Typologically, it is during this time that what constituted a 'portolan map' becomes debatable, because a plethora of other genres of cartography appeared, including Ptolemaic maps, atlases of islands known as 'isolarii', new depictions of the world known as planispheres, regional chorographic maps, more local topographic maps, geographies, and others.

Figure 0.7: A 1541 print of the 1539 G. A. Vavassore woodcut map of the Adriatic and Aegean seas. Greenwich: NMM, G235:1/3. Image available at: <http://collections.rmg.co.uk/collections/objects/540424.html> [Accessed 5 February 2014].

Many of these types of cartography borrowed heavily from the portolan map, and as a result it is somewhat difficult to define what a portolan chart or atlas was. An example of this can be seen in figure 0.7, which depicts the 1539 map by Giovanni Andrea Vavassore, which Leo Bagrow termed "the first printed sea-chart".[71] The map, a woodcut print, clearly borrowed upon several of the characteristics of portolan maps including a a clear focus on the hydrography and toponyms which ran perpendicular to the coastline. However, the map cannot be considered a true portolan map because it lacked the network of thirty-two rhumb lines, and skewed the hydrography to fit everything the map-maker wished onto the given area. The first true printed portolan chart is generally considered to be the 1569 chart by Paolo Forlani, depicted in figure 0.8. This map was based on a manuscript portolan chart by Diogo Homem and contains all the hallmark definitions of a portolan map: hydrography, toponymy, scale, and the rhumb network.[72] It was however, printed, and on paper, thus it is debatable whether the Paolo Forlani chart should be included as part of the genre.

Figure 0.8: A print of the copperplate printed portolan chart by Paolo Forlani made in 1569 after a manuscript chart by Diogo Homem. Milwaukee: American Geographical Society Library, University of Wisconsin, (RARE) 715-1569A. Image available at: <http://collections.lib.uwm.edu/cdm/ref/collection/agdm/id/855> [Accessed 5 February 2014].

The spectrum of mapmaking does not allow for typological divisions to be placed easily, but a general definition for a portolan map might be the following: a clear focus on the hydrography rather than the geography; inclusion of as many toponyms as possible

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[71] Bagrow: (1985), pp. 116-117.

[72] One surviving print of the map is found at: Milwaukee: University of Wisconsin, (AGS) (RARE) 715 A-1569. See: Woodward, David: 'Paulo Forlani: Compiler, Engraver, Printer, or Publisher?', *Imago Mundi*, 44 (1992), 45-64. p. 53.

given the scale, written perpendicular to the coastline; the inclusion of a rhumb network of sixteen (or thirty-two from the fifteenth century onwards) lines; and the shape of the mapped hydrography based on measured directions and distances unbound by a mathematical projection or a coordinate system of latitude and longitude. Astengo posited the end of the portolan map genre occurred in the late seventeenth century, when nautical maps ceased to be constructed on the basis of navigational routes, and began using astronomically-measured coordinates placed according to latitude and longitude.[73]

The historic and cartographic context of the genre of portolan charts, from their inception in the thirteenth century to their replacement by more scientific maps at the end of the seventeenth, provides a useful grounding from which the main body of thesis can discuss the experimentally-derived, historical, and practical evidence to determine the utility of portolan maps. However, the theoretical context must also be elucidated through an evaluation of the theories other scholars have presented arguing for and against the maps' navigational function.

The Utilitarian Hypothesis

Much of the commonly-held assumption that portolan charts were utilitarian has been based on their appearance alone: in comparison with other maps made around the time of the genre's inception, they have a highly recognisable coastline, perpendicular to which were written the names of thousands of ports and cities, identifiable natural littoral markers such as headlands and capes, tall hills, rocks and rivers, as well as man-made towers, beacons and other buildings. In addition, the network of rhumb lines, as wind or compass directions, would seem to impart a sense of utility. However, drawing conclusions based solely on appearance risks anachronistic bias. In other words, simply because they appear to have been more modern, more precise, and more scientific than other maps of the time (e.g. *mappaemundi*), does not mean they can be ascribed a function based on modern preconceptions of how a map ought to appear.

From the earliest research on portolan charts in the late nineteenth century to the present day, the majority of scholarship has presumed a navigational function. Due to their appearance of seeming accuracy, it is unsurprising that this became the commonly-

[73] Astengo: (2007), p. 199.

accepted paradigm. In 1897, Baron Nordenskiöld concluded that 'marine charts' were related to written portolans, and used to guide navigators.[74] Charles Raymond Beazley wrote that they were created as "practical guides to mariners".[75] Oldham called them "equivalents of the modern marine chart" which were "originally made for sailors only, the geography … so far in advance of anything which had been produced by landsmen".[76] Heinrich Winter called them 'compass charts', and concluded that the charts must have been originally created using a compass, and required a compass to be used for seafaring.[77] More recently, James Kelley Jr., in two studies of medieval navigation, dismissed those who had doubted their navigational function, arguing that significant ornamentation did not preclude their utility.[78]

As early as 1926, Caraci posited that the genre might be distinguished separately as navigational or otherwise, and used the term 'carta d'uso' to refer to the former category.[79] However, the first scholar to fully question the true function of the maps was Tony Campbell, who carefully delineated the nuanced functions of the genre, and concluded that they varied between use on board a ship for practical navigation, and archival and administrative use.[80] For the most part, Campbell accepted the common division of charts into two categories: utilitarian aides to navigation, and those "constructed with the pleasure and enlightenment of landsmen in mind", but noted that the boundary between the two had not been established, and that it is quite possible that all from the former category have failed to survive.[81]

Pujades i Bataller discussed the question of function more throughly than any scholar previously or since.[82] His study was limited to the earliest portolan charts dating from the

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[74] Nordenskiöld: (1964), p. 16.

[75] Beazley: (1904), pp. 159-161.

[76] Oldham, R. D.: 'The Portolan Maps of the Rhône Delta: A Contribution to the History of the Sea Charts of the Middle Ages', *The Geographical Journal*, 65: 5 (1925), 403-424. pp. 404-405.

[77] Winter, Heinrich: 'The True Position of Hermann Wagner in the Controversy of the Compass Chart', *Imago Mundi*, 5 (1948), 21-26.

[78] See: Kelley Jr., James E.: *On Old Nautical Charts and Sailing Directions: Technical Essays* (Melrose Park, PA: Sometime Publishers, 1999). esp. p. 81, and Kelley Jr., James E.: *Analog and Digital Navigation in the Late Middle Ages* (Melrose Park, PA: Sometime Publishers, 2000).

[79] Giuseppe Caraci: 'Un'altra carta di Albertin da Virga', *Bollettino della Reale Societa Geografica Italiana*, 63 (1926): 781-86, esp. 783, as cited in: Campbell: (1987), p. 440, (note 489).

[80] Ibid. pp. 438-445.

[81] Ibid. p. 440.

[82] Pujades i Bataller: (2007); Pujades i Bataller: (2009).

late thirteenth century to 1470, and he theorised as to the economic, scientific, and social impetuses that led to their invention, and their overall function. Pujades used an analysis of 159 contemporaneous documentary sources from Catalonia, Majorca, Genoa, Venice and other locations from 1300 to 1500 as primary evidence of the use of charts on ships.[83] Moreover, he presented twenty-four pieces of literature and poetry from the period, from which he argued the presence of nautical charts was far from commonplace and thus permeated the culture instead of remaining solely the instruments of ships' navigators. Pujades' documents noted the existence of a maximum of 228 portolan charts, over thirty *mappaemundi*, and another twenty unclassifiable but possibly cartographic maritime documents. While he acknowledged that some of the documents may refer to the same map, or to current surviving maps, Pujades determined there must have existed "well over four hundred works of nautical cartography from earlier than 1500."[84] His archival evidence, in combination with the maps' visual appearance, documentary sources, and theories as to how the maps might have been used, led him to the conclusion that thousands of inexpensive utilitarian charts were made as aides to navigation, of which few if any currently survive.[85]

However, Pujades' hypothesis had to acknowledge the fact that there is no direct evidence that any of the surviving maps were used at sea, and that so many survivors appear far too luxurious and expensive to have been utilitarian. Within his presented documents however, a divide was revealed between the navigational map and the aesthetic map, as demonstrated in 1408 letters between the Datini in Majorca and their agents in Barcelona: "Abiàn chonprato una charta da navichare ed è buona, ma nonn' è se non per marinieri".[86] The sentence would seem to indicate that there existed marine charts both for and not for mariners. Pujades' conclusion was similar to Campbell's, that charts used on board ships have simply failed to survive.

Under no circumstances can a scholar of late-medieval and Renaissance manuscripts argue that a large or even moderate percentage of manuscripts have survived the last five to eight centuries. Value and use must be taken into account: a highly decorated and

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[83] Many of these documents, their limitations, and their implications are evaluated in Chapter III.

[84] Pujades i Bataller: (2007), p. 439.

[85] Ibid. p. 521.

[86] Prato: Archivio di Stato, Datini no. 891, lett. Maiorca-Barcelona 4-2-1408. Portions of the document are given in: Pujades i Bataller: (2007), p. 436. Personal translation: "We bought a nautical chart and it is good, but not if it is not for mariners". Please note that all translations given in footnotes are personal translations unless otherwise stated.

expensive map would have been treated with more care than an inexpensive utilitarian chart, and as a result would have a greater chance of survival. Pujades suggested that the survival rate of atlases might be comparable to similarly-aged codices because they were bound and probably not meant for navigation, whereas charts would have a lower overall rate of survival.[87] However, Campbell argued that this common assumption was lacking in evidence, and that atlases had as much chance of being navigational documents with some practical advantages over charts.[88] Although there must have existed many more charts and atlases than have survived, the idea of thousands of utilitarian charts, necessary for daily use on board ships is a far-fetched conclusion which requires further scrutiny.

The aim of this thesis is to critically question this well-established 'utilitarian hypothesis', and to do so the following questions will be considered. What evidence is there that portolan maps were used to navigate? How many charts were in circulation and who were the users of these charts? Assuming utilitarian charts were used for navigation, how did production occur and meet both economic and functional demand? In what ways did sailors navigate in the Middle Ages and Early Modern period, how did they change over time, and how might a chart aid that process? If indeed charts were useful or even necessary for navigation, were the hydrography and toponymy apparent on surviving charts accurate enough to be useful? These are some of the questions that this thesis will attempt to answer.

The Counter-Argument

Although the vast majority of scholars have unquestioningly supposed that the primary function of portolan maps were as navigational aides, two scholars have notably disagreed with this supposition. Patrick Gautier Dalché has lamented the lack of research into the function of marine charts, and suggested that most scholars have hastily and anachronistically presupposed their nautical effectiveness.[89] Gautier Dalché highlighted several key problems with the theory that portolan charts were used for navigation. First, he

[87] Ibid. pp. 423-424.

[88] Campbell: (1987), p. 440. He noted the advantages would have included extra protection from the binding, a flatter surface less prone to distortion, and the ability to include coastlines that would not fit on a normal chart without sacrificing scale.

[89] Gautier Dalché, Patrick: 'L'usage des cartes marines aux XIV^{e} e XV^{e} siècles', in *Spazi, tempi, misure e percorsi nell'Europa del Basso medioevo. Atti del Convegno Storico Internazionale*: Todi, 8 - 11 October, 1995. (Spoleto: Centro italiano di studi sull'alto medioevo, 1996), pp. 97-128; ---: (2001).

questioned whether their scale would allow for effective wayfinding, given that one centimetre on the charts depicted a distance of between 45 and 80 km, and in consideration of their local precision, determined that they were crudely generalised and only showed spatial relationships rather than determinable locations.[90] Second, he argued that the connection between the compass (which was primitive and inaccurate at the time of the charts' inception) and the marine chart had yet to be proved.[91] Third, in a discussion of navigation, Gautier Dalché questioned both the ability of ships' pilots to calculate the precise trigonometry needed to work out direct route and actual route, especially given changing winds, and the need of navigators to do so except in situations where land had been out of sight for a long time.[92] Fourth, he noted the lack of information about the charts' origins, pointing out that no theory had yet been developed that demonstrated where, by whom, how, and when the charts were first devised, without which suppositions of their function were merely guesswork.[93] His overall conclusion was that while maps may have been used on board a ship on occasions when the the experience of a navigator failed, the functions of the genre were far more nuanced.

Piero Falchetta additionally questioned the role of portolan charts,[94] and argued that medieval Europeans, even those who were educated, lacked a single definitive model of geographical space that could depict defined spatial relationships, and because of this, map users would always be uncertain of their accuracy, which would have been essential had they been used for navigation.[95] Falchetta also questioned the lack of texts which discussed the use of portolan charts as navigational instruments, despite the existence of many early texts that would otherwise be expected to have done so, citing the fifteenth-century written portolan of Michele da Rodi, Pietro di Versi's *Raxion de marineri*, and others.[96] He went on to discuss that even in written portolans, hydrographic information was often erroneous, and that regardless of whether such information was presented cartographically or textually, "their lack of precision could have been more a danger to than a help for sailors,

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[90] Ibid. pp. 13, 25-29.

[91] Ibid. p. 14.

[92] Ibid. p. 25.

[93] Ibid. pp. 15-20.

[94] Falchetta, Piero: 'The Use of Portolan Charts in European Navigation During the Middle Ages', in *Europa im Weltbild des Mittelalters: Kartographische Konzepte*: Nuremburg, 15-17 June 2006, ed. by Ingrid Baumgärtner and Hartmut Kugler. (Berlin: Akademie Verlag, 2008), pp. 269-276.

[95] Ibid. p. 270.

[96] Ibid. p. 272.

who were likely more inclined to rely on their own experience rather than on portolans and charts."[97] However, he acknowledged that the most probable reason few texts discussed the use of nautical maps was because they were outside the sphere of those scholars' knowledge and experience, and instead rooted in the traditions of merchants and mariners.

Although Falchetta did not conclude that portolan charts were not for navigation, he brought forth many points to be considered, as did Gautier Dalché. These points and others will be evaluated throughout this thesis, which will now proceed to discuss what evidence of function may be gleaned from the archaeological reconstruction of a portolan chart, and assessment of the theoretical methods of their production.

[97] Ibid. p. 274.

I: Construction and Reconstruction

The purpose of this chapter is to examine the ways in which a portolan chart could have been made, and explore the process through the experimental reconstruction of a portolan chart. There has only been one experimental reconstruction of a portolan map: in 1987, Jonathan Lanman published his work on the creation of a chart utilising written sailing directions from two *portolani*.[1] While his work provided evidence to suggest that the charts were compiled through the graphic presentation of written directions, his experiment did not investigate the production process itself. The reconstruction in this chapter has a different aim: to determine how it was that chart-makers copied a preexisting chart, and the time it would have taken to do so. No academic has yet published a reconstruction of this sort, and thus all scholarly discussion of their actual manufacture has been based on what minimal documentary evidence exists, supported by conjecture.[2] Thus, this reconstruction will add valuable practical evidence to support or contradict theories concerning their manufacture.

Unfortunately, no known documents exist which explain the process of drafting or copying a navigational map – or indeed any map – before the mid-sixteenth century, three centuries after the first portolan charts were created. As such, it is impossible to be certain exactly how these maps would have been copied. It is likely that there were no established rules amongst all chart-makers, and instead, each would have utilised the methods with which he was most familiar and practised. Nevertheless, this chapter will explore the methods of compilation, including the experimental copying of a chart to better establish the likely processes. Moreover, the reconstruction will estimate the number of man-hours it would have taken to create a chart. Understanding the production of a portolan chart can elucidate its function. If there was, as Pujades claimed, a near mass-production of functional navigational charts, then certainly they would have needed to be copied quickly to keep their cost down, yet reproduced with utmost accuracy. Furthermore, navigational maps would have required regular toponymic and hydrographic updating. However,

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[1] Lanman, Jonathan T.: *On the Origin of Portolan Charts*, The Hermon Dunlap Center for the History of Cartography, Occasional Publication, No. 2 (Chicago: The Newberry Library, 1987).

[2] For a number of years the Pontifical Institute of Mediaeval Studies in Toronto has run a workshop/course for its students to create *mappaemundi* on parchment. However, no academic publication concerning these reconstructions has been found.

decorative charts would not necessarily have required the same level of accuracy, although their higher cost might have demanded equal precision.

This chapter will begin by discussing the methodology behind the experimental reconstruction, then proceed to analyse each integrant stage of the manufacture of a portolan chart: the reproduction of the hydrography, the drawing of the rhumb network, the scale, the adding of toponyms, and finally the painting of any decorative elements. Each section will synthesize the practical knowledge gleaned from the reconstruction with previous scholarship, to arrive at a more thorough understanding of the method(s) of manufacture, from which a better understanding of the function of portolan charts and atlases may be obtained.

Methodology of the Reconstruction

Experimental Archaeology

The experimental construction and testing of artefacts has been a method within the disciplines of archaeology and anthropology for several years, to varying degrees of success. Prior to the 1970s, experimental archaeology was often viewed as tertiary to more mainstream excavative and analytical archaeology, but a few notable examples drew both archaeologists' and public interest; perhaps the most noteworthy was Thor Heyerdahl's crossing of the south Pacific in his Kon-Tiki balsa wood raft reconstruction, the results of which were published in 1948. Since the 1970s, experimental archaeology has become increasingly accepted, which Toni Carrell attributed to the widening approval of interdisciplinary historical archaeology combining history, art, ethnography and archaeology to achieve a wider understanding of the past. He posited that experimental archaeology, with its ability to demonstrate how things worked, was the "logical next step."[3] In 1973, *Archaeology by Experiment* by John Coles was published, the first core textbook concerning the subject. In the last forty years, experimental archaeology has witnessed a

[3] Carrell, Toni: 'Replication and Experimental Archaeology', *Historical Archaeology*, 26: 4 (1992), 4-13. p. 4.

range of projects from experimental excavation on a modern flint-knapping site,[4] to several ship reconstructions and reenactments,[5] to a 128-year long project at Overton Down.[6]

As a result of decades of investigations, many scholars have discussed the methodology, rules, and limitations of archaeological experimentation. Coles posited that experiments fall into three tiers, the lowest of which is simulation, by which an artefact is copied only in appearance, for the purposes of education. The second tier is to test past processes and methods of production, whereby the manufacture of the experiment is correctly executed according to available knowledge of the technology of the time. The third and highest tier, Coles argued, was the testing of the function of the correctly manufactured artefact, which, often limited by anachronistic bias, requires hypothetical and repeatable experimentation.[7]

Peter Reynolds, director of the Butser Ancient Farm project, wrote of the common misunderstanding (amongst academics practicing experimental archaeology) between true experiment, experience (i.e. acting out past cultural practices), and education (i.e. the communication of results). He explained that the latter two, while worthwhile to achieve a vague understanding, cannot reveal verifiable evidence, whereas true experiment is the scientific testing of a hypothesis, providing confirmed evidence which can be assessed quantitatively.[8] Carrell additionally cautioned that experimental archaeology is more than the making of a replica, and must employ the following 'procedural rules:' the original design must be known; the materials used must be faithful to the original; the method of reconstruction must either be known and replicated, or if itself experimental, must not exceed the knowledge and ability of the time; and finally, the experiment should follow the scientific method, and be repeatable.[9] Above all, Carrell warned that a successful

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[4] See: Coles, John: *Experimental Archaeology* (London: Academic Press, 1979). p. 35.

[5] The Atlantic has been crossed numerous times in replica ships (some more faithful than others), notably three Columbian ships in 1992 to celebrate the quincentennial of Columbus' first voyage, and a year earlier, a Viking longship was rowed across the Atlantic to remind the world that Columbus was not the first. See: Carrell: (1992), pp. 9-10.

[6] Renfrew, Colin et al.: *Archaeology: Theories Methods and Practice*, 3rd edn. (London: Thames & Hudson, 2000). p. 53.

[7] Coles: (1979), pp. 36-40.

[8] Reynolds, Peter J.: 'The Nature of Experiment in Archaeology', in *Experiment and Design: Archaeological Studies in Honour of John Coles*, ed. by A. F. Harding (Oxford: Oxbow Books, 1999), pp. 156-162. pp. 157-158.

[9] Carrell: (1992), p. 5.

experiment does not prove that a past culture did the same, only that they may have, and thus the primary limitation of experimental archaeology is its inherent inconclusiveness.

James Mathieu perhaps provided the most comprehensive definition, and wrote that experimental archaeology is "a sub-field of archaeological research which employs a number of different methods, techniques, analyses, and approaches within the context of a controllable imitative experiment to replicate past phenomena (from objects to systems) in order to generate and test hypotheses to provide or enhance analogies for archaeological interpretation."[10] He went on to explain that experimentation must be controllable, i.e. that its variables are well-understood and appropriately considered, that it tests a hypothesis in a scientific manner, and that the results of experimentation only generate 'analogies' through which the past can be interpreted, not irrefutable proof.

Cartographic Reconstructions

Although archaeological experimentation is currently a thriving sub-field of research, it has yet to significantly breach the traditional discipline of history, and few reconstructions of manuscripts or maps have been published academically. George Carhart's 2004 article discussed the craft practices of engraving copper plates for the purposes of making printed maps.[11] He concluded that a copperplate engraved map for printing could be tooled quickly and meticulously by a skilled craftsman. He posited that the high costs of historically-documented engraving projects were not a result of lengthy production time, but were instead due to the high cost of copper and other workshop expenses.[12] His supposition that engraving could be achieved quickly was based on his own experiment which resulted in a engraved copperplate map measuring 609 cm^2, drawn in twenty hours.[13] However, the experiment was non-scientific, and the engraving far more crude than any comparable copperplate map from the sixteenth-century. He assumed that a

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[10] Mathieu, James R.: 'Introduction', in *Experimental Archaeology: Replicating Past Objects, Behaviors, and Processes*, ed. by James R. Mathieu, British Archaeological Reports, 1035 (Oxford: Archaeopress, 2002), pp. 1-11. p. 1.

[11] Carhart, George S.: 'How Long Did It Take to Engrave an Early Modern Map? A Consideration of Craft Practices', *Imago Mundi*, 56: 2 (2004), 194-197.

[12] Carhart provided the example of the fifty engraved plates Jodocus Hondius provided to John Speed's atlas '*Theatre of the Empire of Great Britaine*' between 1608 and 1611.

[13] Ibid. p. 194.

master craftsman could do the same and much more "in a quarter of the time",[14] which although plausibly true, was unsubstantiated by scientific evidence.

Carhart's assumption was based on a lecture by David Woodward which posited that the workshop of sixteenth-century Venetian master engraver Paolo Forlani (with his assistants) could have engraved the equivalent of 13 x 13 cm daily.[15] Woodward made the calculation thus: the copper plates engraved in 1566 totalled between 29,586 cm^2 for signed maps, and 45,829 cm^2 for all signed and attributed maps, resulting in a range of 81-127 cm^2 per day.[16] Using Goldthwaite's estimated figure of 270 working days in Italy during the sixteenth century,[17] this resulted in a calculation of 109.6 cm^2 to 169.7 cm^2, or roughly between a 10 x 10 cm^2 area to 13 x 13 cm^2 area every working day. However, what Carhart failed to take into account, and Woodward was never able to make clear because the documentary evidence is lacking, was the number of employees who were engraving for Forlani during this time. Woodward acknowledged that there were different styles in the shapes and shading of the topography which indicate he had at least one, and possibly more apprentices.

Carhart and Woodward's historical reconstructions demonstrated the difficulty of drawing conclusions about the output of production. In order to actually assess the time it would take to engrave a copperplate map, a master engraver would need to be commissioned to produce a reconstruction, measuring the time it would take to engrave all stages: from lines, to the topography, to the toponyms. It could be that the only work Forlani did in 1566 was to engrave the place-names, leaving all other tasks to employees. Alternatively, he might have done all the work himself, making Woodward's estimate potentially accurate. However, even if the number of workers Forlani employed in 1566 was known, additional questions still cloud the accuracy of Woodward's estimate: how many hours per day were worked? Did it vary seasonally or according to market forces, or were some of the maps engraved (partially or completely) the previous year and only dated 1566 when the order was finished? Unfortunately it is not possible to know.

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[14] Ibid.

[15] Woodward, David: *Maps as Prints in the Italian Renaissance: Makers, Distributors & Consumers*, The Panizzi Lectures, 1995 (London: BL, 1996). p. 24.

[16] Woodward, David: 'Paulo Forlani: Compiler, Engraver, Printer, or Publisher?', *Imago Mundi*, 44 (1992), 45-64. pp. 55-56.

[17] ---: (1996), p. 107 (note 65).

A reconstruction must begin with a set of questions which the experiment is designed to answer. For the portolan chart reconstruction, the following questions were asked:

1. By what method or methods were portolan charts made? What were the constituent stages of production, and to what extent was their order variable?

2. Are there methods of production that have been posited by academics that could not work? Why would they not have worked?

3. How long did it take to copy a portolan chart? Would it have been possible to make quick and inexpensive copies that were accurate enough for navigation?

4. Would it have been possible to use the reconstructed chart with a pair of dividers ('*sestes*') to measure course and position in theoretical maritime voyages? If not, why?

In order to answer the preceding questions, the following would be the ideal protocol to follow. First, lest the portolan chart reconstruction be simply a replica, period materials must be used. Second, an ideal reconstruction should identify every possible method of production, and test each stage repeatedly for each method. Third, the person conducting the reconstruction must be competent at drafting, calligraphy and map-making, so that the time taken may be considered comparable to a chart-maker from the past. Finally, an ideal reconstruction would test the completed charts in the numerous ways it was believed they were used by the sorts of people that owned them. While a fully comprehensive reconstruction such as this would prove invaluable to the history of cartography, it was not within the scope of this thesis to experimentally investigate production to this extent. The reconstruction actually completed was a more limited investigation, but nevertheless yielded valuable conclusions.

The reconstruction experiment for the present thesis was designed thus:

1. After research into the possible methods of reconstruction, it was found that the constituent stages of making a chart were not significantly variable except in the method of copying the coastline from the exemplar. It was decided to test the method known as '*trasflorar*' as described by Martín Cortés in his *Arte de Navigar*, published in 1545. However, the other possibilities of construction will be discussed theoretically, with the hope that future experimental tests of those methods might better illuminate their potential.

2. Because it would not be possible to make several full-size portolan maps for reasons of time and cost, the experiment involved making two small charts of the Adriatic (one using modern materials and the other medieval materials), and one three-quarter-size chart of the Western Mediterranean using medieval materials.

3. The 1403 Franciscus Becharius chart was chosen to be copied for the experiment. Historically important, Becharius made several hydrographic corrections, intending that they would be copied in the future.[18] The map was also drawn at a slightly larger scale than average portolan charts of the time: roughly 1.6 cm to 50 portolan miles (known as '*miglia*'), instead of the more usual 0.9-1.1 cm,[19] making it more likely to have been an exemplar. As it would not be possible to directly copy any actual surviving manuscript for reasons of conservation, it was necessary to choose a map for which a high-quality digital facsimile existed.[20]

4. One of the primary goals of this reconstruction was to determine how long it would take to make a portolan chart. For each constituent stage in the production process, the time was recorded. These results could then be analysed and extrapolated to determine how long each stage would take according to the size of the map, number of toponyms, number of rhumb lines, decorations, etc. Furthermore, personal competence at map-making, drafting, and calligraphy may be taken into account.[21]

The chapter will now analyse in detail each stage of the production process, discussing both the documentary sources, and what was learned from the reconstruction. Following this, the overall results of the reconstruction experiment will be presented.

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[18] Becharius' intentions are known from a text he included on the chart, known as his 'Address to the Reader', which is discussed in detail in the Becharius case study in Chapter II. A translation is provided in: Kraus, H.P.: *Twenty-Five Manuscripts* (Vaduz, Liechtenstein: Rare Books, 1961). pp. 63-64.

[19] Pujades i Bataller, Ramón J. : *Les cartes portolanes: La representació medieval d'una mar solcada*, trans. by Richard Rees (Barcelona: Institut Cartogràfic de Catalunya, Institut d'Estudis Catalans, Institut Europeu de la Mediterrània, 2007). p. 204.

[20] Becharius, Franciscus (February 1403): New Haven: BRBML, 1980.158. <http://brbl-dl.library.yale.edu/vufind/Record/3521236> [accessed 12 April 2012].

[21] Before undertaking the reconstruction, I had personally made several artistic manuscript maps in eighteenth and nineteenth-century styles using dip-pens and ink; an example is shown in figure 1.1. Because of my personal competency at drafting, calligraphy, and map-making, the time taken to complete constituent stages of production in the reconstruction should be comparable to that of an apprentice chart-maker.

Figure 1.1: One of two hand-drawn maps of the City of Durham, completed in 2012 before the portolan chart reconstruction, which demonstrate my personal competency at map-making.

Constituent Stages of Producing a Portolan Chart

Before proceeding, it is first necessary to identify the constituent stages of production and their (likely) order, before analysing each of them sequentially. The past few decades have witnessed some scholarship on the production of portolan charts, though doubtless more could be done. In 1987, Campbell briefly discussed the possible methods of production, but noted "no study of portolan draftsmanship has yet been made."[22] Also in 1987, Jonathan Lanman published a monograph of his experimental drafting of charts using two written *portolani*: *Lo Compasso de Navigare* (dating to no later than 1296, but a copy of an earlier work), and the *Parma-Magliabecchi portolano* (four versions of which date to the fifteenth century, and a fifth to the sixteenth century).[23] Lanman demonstrated that a portolan chart could be constructed using written sailing directions, which greatly contributed to our understanding of the origins of portolan charts and how one might draft an exemplar using triangulation of known directions and distances. His study however, did not explore methods of copying an already existing exemplar.

Both Pujades and Astengo discussed the manufacture of portolan maps,[24] and each presented a well-cited document by the Spaniard Martin Cortés de Albacar titled *Breve Compendio de la Esfera y del Arte de Navigar*, a navigational treatise written in 1545, published in Seville in 1551, and dedicated to the Holy Roman Emperor Charles V.[25] Within a century it had been translated into numerous languages, and nine English editions were printed between 1561 and 1630.[26] Historians of cartography have enthusiastically seized upon Cortés' two explanations of how to copy a navigational map, which appear in his second chapter of the third part of his manual. While it is unwise to accept Cortés' explanation as the definitive methodology – a sentiment echoed by Pujades[27] – his explanation nevertheless provides a useful guide of the constituent stages of production.

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[22] Campbell, Tony: 'Portolan Charts from the Late Thirteenth Century to 1500', in *The History of Cartography*, ed. by J. B. Harley and David Woodward, 3 vols. (Chicago: UCP, 1987), vol. 1, pp. 371-463. p. 390.

[23] Lanman: (1987), p. 3.

[24] Astengo, Corradino: 'The Renaissance Chart Tradition in the Mediterranean', in *The History of Cartography*, ed. by David Woodward, 3 vols. (Chicago: UCP, 2007), vol. 3, pp. 174-262. pp. 185-189; Pujades i Bataller: (2007), pp. 471-483.

[25] Cortés, Martín de Albacar: *Breve Compendio de la Esfera y del Arte de Navigar* (Seville, 1551). <http://documentomovil.usal.es/visor.php?f=nautica_bg_CortesAlbacar&v=dicter&p=1> [accessed 22 January 2013], p. 4 (f. 1r).

[26] Pujades i Bataller: (2007), p. 471.

[27] Ibid. p. 472.

The steps described by Cortés were as follows. First, using parchment of the required size, two perpendicular black lines were drawn (north-south and east-west), intersecting at the middle of the parchment. Second, a "hidden circle" was drawn over the entire chart, the middle of which intersected with the aforesaid lines.[28] Third, the network of rhumb lines was drawn out from the centre point: the eight 'winds' in black, 'half-winds' in green or azure, and sixteen 'quarter-winds' in red. If the chart was large, Cortés recommended drawing additional parallel lines from the points that emerge from the convergence of rhumbs outside the circle.

Fourth, transparent paper was secured over the map that was to be copied, and the coastline traced, using the north-south and east-west lines for reference. Fifth, once the hydrography was copied, the traced paper was secured over the new map using the rhumb lines as a guide, and smoked paper was placed between the two, face down. A blunt stylus was used to press along the coastline on the paper to transfer the smoke onto the parchment of the new map. Sixth, the toponyms were written, beginning with red, and then black, exactly as they were on the exemplar.

Seventh, Cortés wrote to draw and paint all the cities, ships, banners, and beasts, write in the regions, and beautify the cities, compasses and other ornamentation. Eighth, where there was room, two parallel lines were drawn that were at least 300 leagues in length, and using dividers, 100 leagues in length was transferred to the new chart to make the scale. Finally, Cortés said to copy the latitudes by degrees near the Azores as is depicted in the exemplar.[29]

Parchment

The vast majority of surviving portolan charts and atlases that have survived were produced on animal parchment, and until very late in the life of the genre, were drawn and

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[28] Cortés called this a 'circulo oculto'. See: Cortés: (1551), p. 126 (f. 62r). He also noted that lead may be used and later erased using bread.

[29] If the exemplar was not graduated, 87.5 leagues was to be measured with dividers, divided into five, and each marked as a degree, with cape St. Vincent marked as 37 degrees north. Cortés discussed that different charts had different measurements of the length in leagues of degrees, between 17½ and 16⅔, because some chart-makers measured leagues from degrees, and vice-versa.

written manuscript.[30] Although the earliest printed portolan chart was made in 1569,[31] Koeman discussed that few portolan charts were printed on parchment until 1580, when Dutch cartographers Waghenaer and Doetsz were the first to develop a process to better allow the ink from a copperplate to adhere to the vellum, which was more resistant and stiff than paper.[32] A considerable amount of scholarship has been published on the making and preparation of parchment in the medieval and early modern period, so it is unnecessary to go into detail.[33] The making of parchment was a lengthy and malodorous process, generally carried out in specialist parchment-making workshops. Certainly by the early thirteenth century, the parchment used would have been purchased from merchants, and not made by chart-makers themselves.[34]

Paper production in Europe appeared around the same time as the first portolan maps; paper mills were established in Spain and Italy in the thirteenth century.[35] However, parchment seems to have been the preferred substrate for late-medieval cartography. Parchment was probably desired for its durability, but while it is known today that parchment survives longer than paper, De Hamel suggested that medieval scribes did not necessarily believe this at the time.[36] Pujades theorised that parchment was used in the production of portolan charts for its ability to "withstand damp and stretching."[37] While a chart used at sea would invariably become damp, the repetitive process of getting wet, drying out, getting wet again etc. would actually lead to considerably more stretching and warping of parchment than paper, which would ultimately render the chart's rhumb lines

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[30] Pujades and Campbell mentioned the existence of one atlas (Rome: BAV, MS. Rossiano 676) and one chart (Milan: Biblioteca Ambrosiana, SP II 59) that were produced on paper: Pujades i Bataller: (2007), p. 483 (note 7). and Campbell: (1987), p. 376 (note 48).

[31] The earliest printed portolan chart was engraved in 1569 by Paolo Forlani and printed on paper in Venice (Milwaukee: University of Wisconsin, AGS RARE 715 A-1569), following a manuscript exemplar by Diogo Homem, but printed portolan charts nevertheless remained incredibly rare. See: Woodward: (1992), p. 53, and Astengo: (2007), p. 217.

[32] Koeman, C.: 'The Chart Trade in Europe from its Origin to Modern Times', *Terrae Incognitae: Annals of the Society for the History of Discoveries*, 12 (1980), 49-64. pp. 53-54.

[33] The manufacture of parchment is well-documented in primary texts such as the twelfth-century *Schedula diversarium artium* by Theophilus Presbyter, or the eighth-century *Lucca* manuscript. Secondary texts discussing the manufacture of parchment include: Reed, R.: *Ancient Skins, Parchments and Leathers* (London: Seminar Press, 1972), and De Hamel, Christopher: *Scribes and Illuminators* (London: British Museum, 1992).

[34] Falchetta, Piero: *Marinai, mercanti, cartografi, pittori: richerche sulla cartografia nautica a Venezia (sec. XIV-XV)* (Venice: Atento Veneto, 1995). p. 72.

[35] De Hamel: (1992), p. 16.

[36] Ibid.

[37] Pujades i Bataller: (2007), p. 472.

curved and the littoral contorted. For this reason – as Campbell suggested – if portolan maps were used at sea, they were more likely in the form of atlases, of which each map was pasted onto rigid board which would prevent warping.[38] It might have been that parchment was instead chosen for its sumptuousness and expense. Possibly, less expensive functional nautical charts might have been produced on paper, and have simply failed to survive given the conditions in which they were used.

For the production of charts, the chart-maker would either choose a single large parchment, arrange the spine of the animal east-west, and trim it of irregular scraps. For extra-large charts, two pieces of parchment would be glued together with the spine arranged north-south. Nearly every chart was drawn on the flesh side of the parchment, because it was whiter and smoother. Early charts retained the neck portion of the animal parchment, which was most often positioned to the west, while later charts (and charts comprised of two pieces of parchment) might trim that side into a curve or slice off the corners at an angle.[39] It is generally agreed that the neck was left on the charts as a location to attach a wooden cylinder around which the chart could be rolled or from which it would be hung.[40]

The orientation of the neck however, has been a matter of debate; early portolans (including the late-thirteenth-century *Carte Pisane*) had their necks positioned to the east, which reversed by the fifteenth century to be predominantly positioned westwards. James Kelley suggested that the switch was a result of a shift away from eastern and towards western trade routes,[41] whereas Tony Campbell posited that early chart-makers preferred east at the neck (top) following the tradition of *mappaemundi*.[42] Pujades challenged Kelley's explanation that the birthplace of portolan charts was the Ligurian coast, for which trade routes were initially more westward than east.[43] A survey of the charts included on Pujades'

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38 Campbell: (1987), p. 440.

39 Astengo provided a good summary of the preparation of parchment by chart-makers: Astengo, Corradino: 'La Fabbricazione de Carte ed Atlanti Nautici', *Studi e Ricerche di Geografia*, 17: 2 (1994), 153-172.

40 Astengo: (2007), p. 182.

41 Kelley Jr., James E.: 'The Oldest Portlan Chart in the New World', *Terrae Incognitae: Annals of the Society for the History of Discoveries*, 9 (1977), 22-48. p. 24.

42 Campbell: (1987), p. 378 (note 62).

43 Pujades i Bataller: (2007), p. 473

DVD of facsimiles indicated a shift from an eastwards to a westwards focus.[44] However, the switch was by no means unanimous, and a more likely explanation is that the neck was positioned where extra space was needed, and coincided with the addition of the Azores in 1439, and the Cape Verde islands in 1468.[45]

Although in manuscript book production both sides of the parchment were written upon, portolan atlases were constructed differently: the hair-side of the parchment was pasted onto card or wood boards or to each other, and like charts, only the flesh side was drawn upon. Figure 1.2 depicts how a typical atlas was constructed. Usually, each map was drawn across the entire parchment from verso to recto. Because of this, it is most likely that the individual maps were fully made before being fixed onto the boards. Additionally, there are a few examples of atlases constructed to fold out in an accordion-like manner.[46]

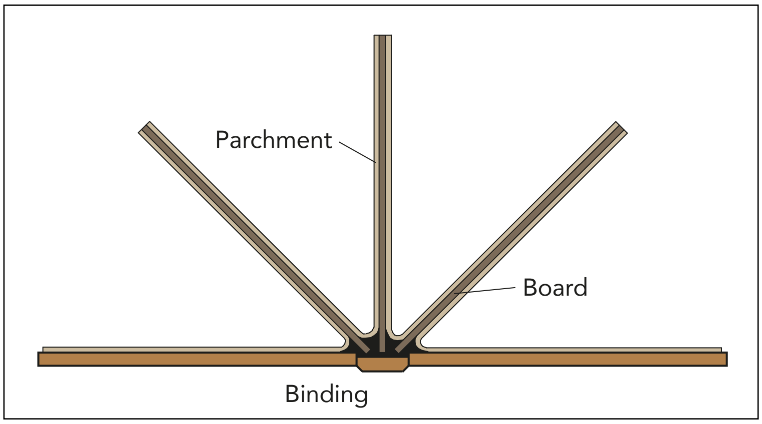

Figure 1.2: The construction of a typical atlas, showing that adjacent verso and recto folios were a single continuous piece of parchment.

The Reconstruction: Parchment[47]

The parchment used for the reconstruction was a calf-skin measuring an irregular 60 x 90 cm, purchased from parchment manufacturer Pergamena. Unfortunately, they were unable to supply a parchment with the 'neck' included, so it was trimmed down to

[44] Of the twenty-three visible charts up to 1400, the neck was positioned to the west on eight, east on seven, six were trimmed or fragmentary, and two were composed of two sheets. From 1401 to 1470 (when Pujades' study ended), there were twenty-four to the west, nine to the east, eleven trimmed or fragmentary, one double-sheet, and two with the neck towards the south.

[45] Though Cortesão believed Terceira first appeared on the 1367 Pizigano chart, the first surviving portolan map to depict the Azores with certainty was the 1439 Valseca chart. See: Campbell: (1987), pp. 410-411 (note 296).

[46] Two atlases dating to 1555 and 1556 by Angelo Freducci were constructed in this format, along with a couple of others. See: Astengo: (2007), p. 184.

[47] The purpose of the inset text boxes within each section is to separate (for reasons of clarity) the specific experimental process utilised in the reconstruction itself from the more academic discussion in the main text.

a rectangle measuring 48 x 74 cm. The hair side had been treated with pounce for writing, rather than the flesh side as would have been more appropriate. Without access to the tools or pounce to prepare the flesh side correctly, it was decided to proceed with the reconstruction on the hair side. Although not the side commonly used, the hair side should not affect the results of the reconstruction significantly.

Inks and Other Materials

There is no document that reveals exactly which tools medieval and early modern cartographers used beyond those of a scribe. Christopher De Hamel wrote one of the best guides to the methods and materials of medieval scribes, thus it is unnecessary to go into great detail concerning the history and production of every scribal tool.[48] The standard toolkit for any portolan chart-maker would have included the following: black, red, and green inks, quill pens, a very sharp penknife, styli, a lead plummet, and several straight-edges which were probably ruled. Figure 1.3 shows the corner decoration from the 1318 Petrus Vesconte atlas[49] depicting a chart-maker, who (it can be assumed) is Vesconte himself, working at a sloped writing desk like other scribes of the time.[50]

Figure 1.3: The top left corner of the 1318 Petrus Vesconte atlas (f. 2v). Venice: Museo Correr, port. 28. Image from Pujades i Bataller (2007) DVD Supplement.

Additionally, chart-makers had a pair of compass dividers known as ‘*sestes*’.[51] Generally, these dividers were made of brass to prohibit rusting, and were used – according to Pujades and other scholars – to estimate the course travelled at sea. However, they would have also been used in the drafting process: in his *Arte de Navigar* of 1545, Cortés instructed one to draw a large ‘hidden circle’ (*circulo oculto*) to begin the rhumb line network, by which

[48] De Hamel: (1992).

[49] Vesconte, Petrus: *Portolan Atlas*, (1318): Venice: Museo Correr, port. 28 f. 2v.

[50] De Hamel: (1992), p. 37.

[51] Pujades discussed the terminology between the words ‘sestes’ and ‘compasso’, concluding from inventories that both were used interchangeably to refer to a draftsman’s compass, whereas ‘bussola’ was the term used for a magnetic compass. Pujades i Bataller: (2007), p. 442.

he meant using a pair of dividers: one point securely fastened in the centre of the chart, and the other scratching or indenting the parchment in a circle.[52] The dividers were also used to divide the circle into smaller equal sections.

Though chart-makers cut their own quill pens, as did every scribe, it is unknown whether a chart-maker or his atelier would have produced the inks. The black ink was either the richly dark iron-gall ink, or the less dark carbon-black ink, which became increasingly rare for scribal use during the Renaissance.[53] Initial examination of portolan maps suggests that individual chart-makers preferred one type or the other for their entire corpus, but certainly more examination is needed before any conclusions can be made. A future study of the consistency of ink colour across all surviving maps of each chart-maker might suggest whether they tended to mix their own, or bought pre-prepared inks.

The Reconstruction: Inks and Other Materials

Pre-manufactured inks were used in the reconstruction for the following reasons: first, the lack of experience at manufacturing inks would result in inconsistencies; second, it is unclear whether chart-makers made their own inks; third, it was beyond the scope of the reconstruction to measure the time it would take to make ink; and fourth, traditional medieval red and green inks were highly toxic. The inks chosen were Windsor & Newton water-based 'Calligraphy Ink'.

A dip-pen with steel nibs was chosen instead of a quill, the reason being that having considerable personal experience with calligraphy dip-pens of this sort, but not with quill pens (and the process of cutting/sharpening them), steel nibs would more closely approximate the speed at which an experienced chart-maker could produce a portolan map. Although a quill pen would have been more accurate, using one might have significantly skewed the results.

Other tools included a ruled straight-edge, a steel compass with two metal tips and a penknife. It was not possible to obtain a lead plummet.

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[52] Cortés: (1551), p. 126 (f. 62r).

[53] De Hamel: (1992), p. 32.

Drawing the Rhumb Network

The first stage in actually making a portolan chart would have been to draw the rhumb line network. This network consisted of one (or sometimes two) circle(s), as wide as the map could accommodate. Out of the centre of the circle(s), thin black lines were drawn every 45º: north-south, east-west, northeast-southwest, and northwest-southeast. These black rhumbs represented the eight cardinal directions, or 'winds'.[54] Halfway between every black line, a green rhumb was drawn, 22.5º away from the black lines, and 45º away from each other, representing the 'half-winds', e.g. north-northeast, or west-southwest. These sixteen lines intersected the circle at sixteen points, and from each, these sixteen black and green rhumb lines were repeated. Additionally, from each of the points around the circle, sixteen red lines splitting the space evenly (11.25º degrees away from its adjacent black and green neighbours) were drawn, representing the 'quarter-winds'. The result was a network of numerous parallel lines across the map, angled at every 11.25º degrees.

In order to align the coastlines on the exemplar and the new copied map, it was necessary to draw at least one single line, most likely east-west (being the longest direction) before copying the littoral. However, the entire rhumb network might have been copied before tracing the coastline. Scholars have debated which came first for decades, with no consensus. There has been indication on a few maps that both the hydrography and the toponymy were copied before the rhumbs. While it may seem that the argument is trivial, Pujades noted that whether or not the rhumbs were drawn first indicates whether they were necessary in the configuration of the coastline, or if they played a part in copying it.[55] Most scholars believe however, that there is no evidence to suggest the rhumb network was used to copy the littoral from one chart to another, for the simple reason that no two portolan charts have a rhumb centre in the exact same location, which would have been necessary for copying.[56] However, as Lanman and Mollat du Jourdin explained, a full rhumb network would have been vital to plot coordinates taken from a written portolan.[57]

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[54] Clockwise from north, these were: *Tramontane*, *Gregale*, *Levante*, *Sirocco*, *Ostro*, *Libeccio*, *Ponente*, and *Mistral*.

[55] Pujades i Bataller: (2007), p. 473.

[56] Campbell: (1987), p. 392; Astengo: (2007), pp. 185-186; Pujades i Bataller: (2007), p. 474.

[57] Lanman: (1987), pp. 33-34; Mollat Du Jourdin, Michel et al.: *Sea charts of the early explorers : 13th to 17th century*, trans. by L. Le R. Dethan (New York: Thames and Hudson, 1984). pp. 11-13.

Electron microscopy carried out by Campbell on four charts at the British Library confirmed that the rhumb lines were underneath (thus drawn before) both the coastline and the toponyms on three maps, while the fourth was ambiguous but suggested the same.[58] Two fragmentary and unfinished charts discussed by Pujades showed one with its entire rhumb network and scales completed but without the coastline or toponyms, yet another with only the black rhumbs drawn, but with its coastline and black toponyms.[59] The most likely scenario was that individual chart-makers proceeded in whatever order they were taught and with which they were most comfortable.

If the charts were for navigation, then the clarity of their coastlines was of paramount importance; thus it would have been sensible to make certain that the points where rhumb lines converged (which, as the figures show, is visually disruptive) did not fall upon the littoral, but instead in the sea or inland, and far enough away so that the lines did not interfere with the toponyms. Although this was probably not possible in every circumstance, it would have been advantageous to keep the coastline as clear as possible. Theoretically, the most useful order would have been to draw only the central N-S and E-W lines and then copy the coastline before drawing any other rhumbs, or even drawing the 'hidden circle'. By doing so, the minimal lines would still allow the chart-maker to align the copy correctly, but also resize the radius of the 'hidden circle' so that none of the sixteen

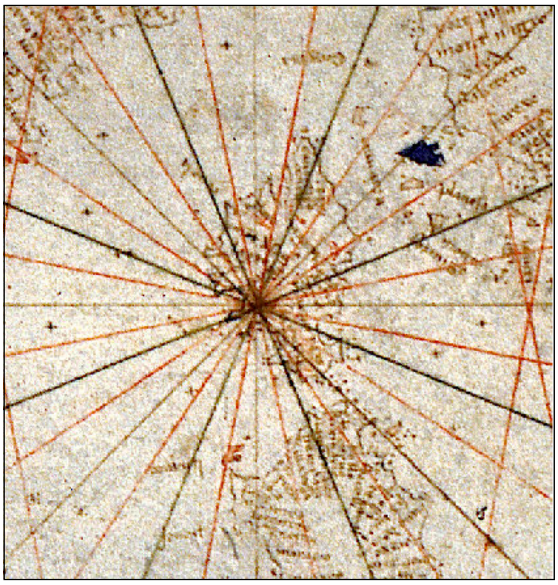

Figure 1.4: Rhumb line convergence in an anonymous chart. Naples: BN, MS. XII.D. 102. Image from: Pujades i Bataller (2007) DVD Supplement.

Figure 1.5: Rhumb line convergence in the 1447 Roselli chart. Volterra: BG, MS. C.N. 1. Image from: Pujades i Bataller (2007) DVD Supplement.

[58] Campbell: (1987), pp. 390-391.

[59] Pujades i Bataller: (2007), pp. 189, 473.

points of convergence would interfere with the coastline. Alternatively, if the rhumb network had been drawn already, the chart-maker might have been able to align the tracing itself so that the coastline did not overlap, though more than likely this was often difficult to accomplish if the hydrographic content extended to the edges of the parchment.

Despite this advantage, examination of multiple portolan charts revealed several instances where convergences disrupted the coastline, indicating that the cartographers drew the rhumbs before copying the coast: examples can be seen in figures 1.4 and 1.5. Additionally, there were a few instances where it appeared the chart-maker possibly did consider the relationship of the placement of the rhumb network to the coastline. One example is the 1468 'Atlantic Chart' by Gratiosus Benincasa,[60] shown in figure 1.6. The positioning of the central point seems consciously centred in the bay, but it could be coincidental. It is unlikely that any maker would have deliberately chosen to disrupt the coastline, so either they did not know that by following the procedure outlined above they could have accomplished this, or it was not considered necessary to keep the coastline free from disruption, which controverts navigational utility.

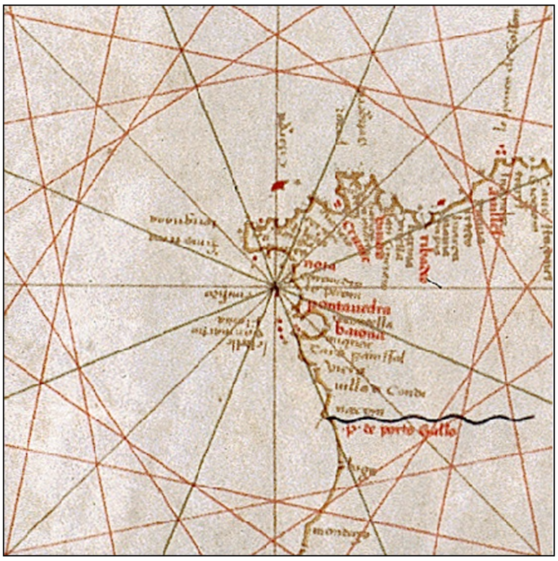

Figure 1.6: Rhumb line convergence from the 1468 Gratiosus Benincasa chart. Palma de Majorca: FBMS. Image from: Pujades i Bataller (2007) DVD Supplement.

The Reconstruction: Alignment and Rhumb Network

The second and third chart reconstructions were made after it was discovered to be an advantage not to copy the entire rhumb network before the coastline for the reasons outlined above. Thus in both, only a few N-S and E-W lines were drawn, in order to correctly align the copy with the exemplar. Figure 1.7 shows the second experimental portolan chart: the littoral of the Adriatic was specifically adjusted so that the convergence point in the top right was not on the coast itself, or inland, which

[60] Benincasa, Gratiosus: *'Atlantic Chart'*, (1468): Palma de Mallorca: Fundación Bartolomé March Servera, (no reference number).

would have made writing the toponyms difficult. It was only after the coastline had been copied that the remaining black, and all red and green rhumb lines were added.

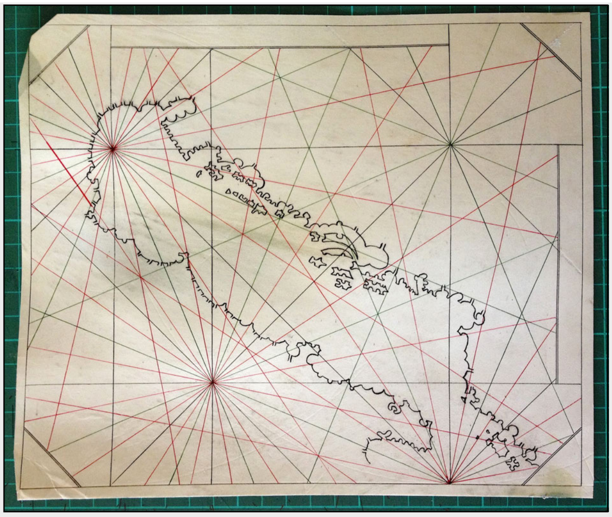

Figure 1.7: The second reconstruction, whereby the coastline of the Adriatic was specifically adjusted to not coincide with the top-left rhumb line convergence.

Several test drawings of rhumb networks were made to become familiar with the drawing. From these first tests, it became readily apparent that contrary to Cortés instructions, the area(s) designated to be used for the scale(s) required planning and designating with an outline (in lead, or scored with a stylus) before any rhumb lines are drawn (except perhaps the initial N-S and E-W lines). If they were not initially planned, they would have superimposed upon the rhumbs, which would be visually apparent and messy, or time would have had to be taken to erase the lines where necessary. The rhumbs on most portolan charts generally appeared to stop at borders or scales, indicating a clearly planned layout. The following table indicates the times it took to draw six different rhumb networks in the experimentation:

No.	***Materials***	***Size***	***Total Lines***	***Time***	***Time/ Lines***
1	Modern*	A4 (210x297mm)	136	42m:38s	18.8s/line
2	Modern	A3 (297x420mm)	126	39m:41s	18.9s/line
3	Modern	A3 (297x420mm)	96	31m:00s	19.4s/line
4	Modern	200x268mm	96	35m:49s	22.4s/line
5	Traditional†	187x225mm	53	1h:47m:08s	121.3s/line
6	Traditional	481x737mm	130	3h:46m:26s	104.5s/line

* Modern materials included black, green, and red ballpoint pens, a compass (with graphite), a steel ruler, and paper.

† Traditional materials were a dip-pen with steel nib, bottles of black, green, and red inks, compass (with two metal points), a straight-edge, and calfskin parchment.

The results indicated two aspects regarding rhumb line networks. First, the temporal disparity between a modern ballpoint pen and a dip-pen is readily apparent: the extra time of the latter was caused by the dipping and flicking off of excess ink (which might otherwise blot), and the slower motion, steadier hand, and angle of the pen necessary for a consistent line across the parchment. Second, the experiments revealed that much of the time spent was not the drawing of the line itself, but adjusting the straight-edge so that the line would perfectly intersect the nodal points. This was even more difficult on the large parchment (no. 6 above), due to its undulating surface.

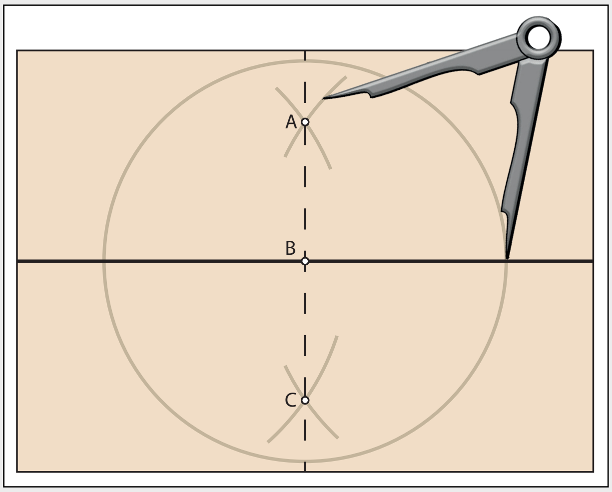

Figure 1.8: The likely method used to subdivide an arc of a circle perfectly in half, using dividers.

The times indicated above also included the drawing of the 'hidden circle', and subdividing it into the sixteen equiangular points. Without a modern protractor, this was accomplished with dividers. Once the single E-W line was drawn, and the circle scratched into the parchment, using the dividers set at a larger radius than the circle, one would indent two intersecting arcs on the parchment, as shown in figure 1.8. A line drawn between the three points A, B, and C, would be at a 90º angle to the E-W line. The same method was used to subdivide the circle again into eight, and again into sixteen, as shown in figure 1.9. Analysis of portolan charts may reveal these arcs impressed onto the map, though they may have disappeared due to the elasticity of parchment.

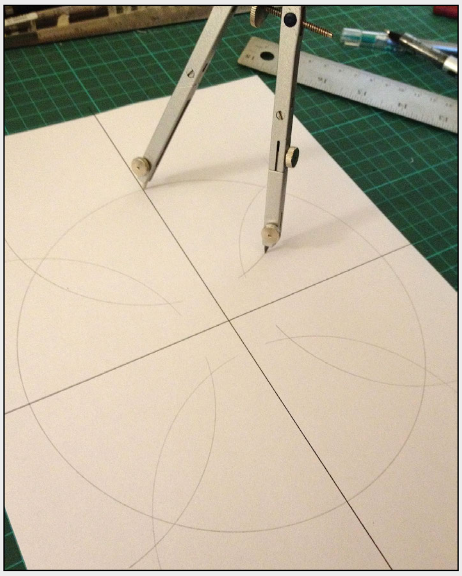

Figure 1.9: Subdividing arcs of a circle using a compass.

Rhumb networks were not as simple as drawing thirty-two lines intersecting each of the sixteen points around the circle (resulting in 136 lines total). Several rhumbs were intentionally left undrawn if they were unnecessary. The overwhelming pattern for rhumb networks, as determined by both experimentation and viewing extant charts, seems to be the following:

1. The eight full winds in black and eight half winds in green were drawn out from the centre. Rarely (in later or larger maps), the sixteen red quarter winds also emerged from the central point, but far more often these were only drawn from the sixteen points around the circle, as shown in figure 1.10.

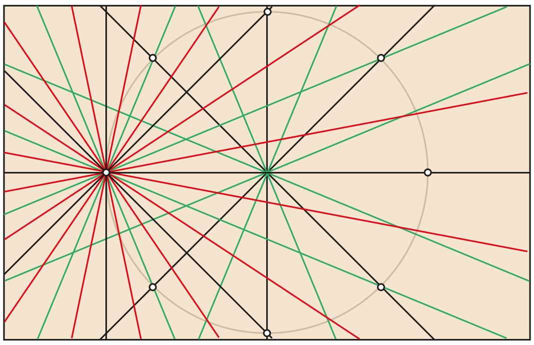

Figure 1.10: Rhumb network showing all lines drawn from the central and left-most points.

2. The outer black rhumbs were usually drawn tangentially to the circle out of the eight full-wind points (N, NE, E etc.), rather than intersecting the two half wind points (NNE, ENE, ESE, SSE etc.) and bisecting the circle, as shown in figure 1.11. Only very rarely were both of these parallel lines drawn.

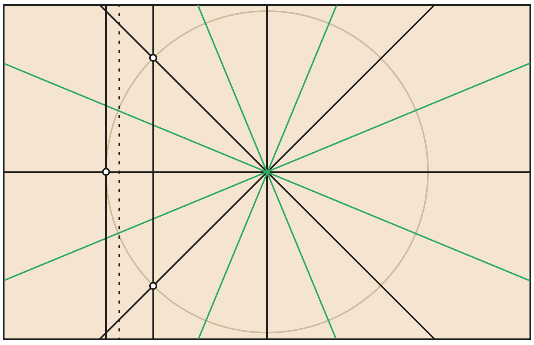

Figure 1.11: Rhumb network showing the typical drawing of the black lines. Only rarely would the dotted line have been drawn.

3. It was the opposite for green rhumbs, which usually bisected the circle, as shown in figure 1.12. There seemed to be a favouring for the eight full-wind points to have all thirty-two rhumbs emerging from them, rather than from the other points around the circle. From experimentation, this network pattern was the result of drawing only the black network first, then adding the red and green lines later.

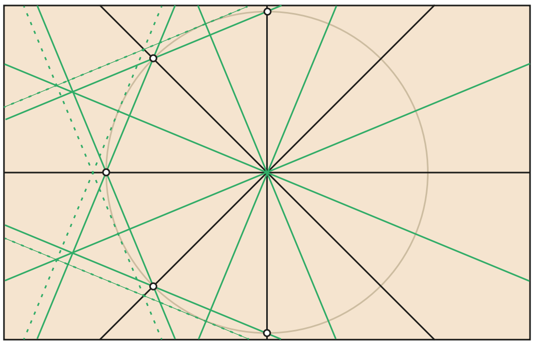

Figure 1.12: Rhumb network showing the typical pattern for the green rhumb lines. Only rarely were the positions of the dotted lines favoured over the solid lines.

4. On most portolan charts, the intersections of the four cardinal directions with the circle have all thirty-two lines. Usually, NW, NE, SW, and SE also have thirty-two

lines with the exception of red rhumb lines running between adjacent points, which were often not extended beyond the circle, or omitted entirely.

5. Early portolan charts had a greater tendency to only draw from point to point, and never leave the circle. By the fifteenth century however, most rhumbs were drawn to the edge of the parchment, as Cortés indicated.

Examination of numerous portolan maps revealed that individual chart-makers had a certain rhumb network pattern they usually followed. For instance, in his atlases, Gratiosus Benincasa drew all lines from each of the sixteen points around the circle to all other points except to the nearest two points on either side, but did draw the lines to the edge of the parchment (border). Petrus Vesconte, in his atlases, did much the same but skipped the nearest three on either side, and did not draw beyond the circle, unless the coastline extended beyond the circle.

While there were general patterns, overall, chart-makers followed their own style, both in which lines they drew and which they omitted, and in what order they drew the network in relation to the coastline. Much the same way as wind roses have been used to attribute authorship to anonymous charts,[61] the patterns of rhumb networks might prove useful. Certainly the rhumb network was an integral part of a portolan chart, not only in terms of its utility, but also for its aesthetic and spiritual function. The translation of Euclid's *Geometry* into Latin by Adelard of Bath (c.1120), and the rise of the medieval universities in the twelfth and thirteenth centuries, led to great interest in geometry and cosmography. In his *Opus Majus* of 1260, Roger Bacon indicated that he believed mathematical geometry was a reflection of the mind of God, and Robert Grosseteste emphasized a similar importance of geometry in his *De lineis, angulis et figuris* (c. 1220-1235).[62] A rhumb network, composed of a perfect circle with geometrically-precise triangles and squares, was likely seen as aesthetic in and of itself.

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[61] Winter, Heinrich: 'A Late Portolan Chart at Madrid and Late Portolan Charts in General', *Imago Mundi*, 7 (1950), 37-46. p. 38.

[62] Kibre, Pearl: *Studies in Medieval Science: Alchemy, Astrology, Mathematics and Medicine* (London: Hambledon Press, 1984). pp. I:184-185; Grant, Edward: *The Nature of Natural Philosophy in the Late Middle Ages* (Washington D.C.: Catholic University of America, 2010). pp. 25-26. The aesthetics of proportion and geometric symmetry have also been discussed by: Eco, Umberto: *Art and Beauty in the Middle Ages*, trans. by Hugh Bredin (New Haven: Yale University Press, 1986). pp. 28-51.

Copying the Coastline

The next step, according to Martín Cortés, was to copy the coastline from the exemplar to the new chart.[63] Before the advent of printing, there were only six ways to manually copy one image to another. The first, and most basic, was to simply draw freehand, looking from one image to another, and occasionally use some sort of instrument to make measurements. For highly complex images, such as portolan charts, this method would have been difficult and erroneous, and it can be assumed that chart-makers did not opt for this method. The second involved subdividing both the exemplar and copy into measured smaller areas before copying freehand to minimise the introduction of error, from one subdivision to its equivalent. This could be done with a grid of squares, rectangles, or triangles, though a square grid would have been the easiest to use.[64] The third method was to pinprick around the drawn areas of an exemplar and then force a fine powder known as pounce through the pinpricks to create small dots on the copy behind.[65] Then ink would have been used to connect the dots. The fourth method was to trace the image directly using a strong backlight. The fifth was to use some sort of transfer material (similar to carbon-copy sheets) to transpose the coastline. A sixth and final method might have been to use a camera obscura to project an image. Although the earliest theories of the camera obscura can be traced to the tenth-century Arabic scientist Ibn Alhazen, Roger Bacon and his followers in the 13th century, and Leonardo Da Vinci in the early 16th, the earliest experimental cameras obscura used only a pinhole and reversed the projected image.[66] Without adding a mirror, lens and diaphragm,[67] a camera obscura would have been too blurry and faded to project an adequate image of a portolan chart to be a plausible method, at least until the late sixteenth century.

Ruling out the first and last of the six methods, there were only four ways in which portolan charts could have been copied. Campbell (1987) commented that "no study of portolan draftsmanship has yet been made" but briefly discussed the potential methods of

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[63] Cortés: (1551), pp. 128-134 (ff. 63r-66r).

[64] Whatever shape was used, the sides and angles had to be consistent (though the scale could have been enlarged or reduced).

[65] Another similar possibility was that the two parchments were sewn together, with the needle holes running through the coastline. The thread was then removed and ink used to connect the holes. Although possible, it is likely this would have been rather labourious and slow. Nevertheless, my thanks to Dr. Thomas Ball for providing this idea.

[66] Wade, Nicholas J. et al.: 'The eye as an optical instrument: from camera obscura to Helmholtz's perspective', *Perception*, 30: 10 (2001), 1157-1177. p. 1159.

[67] This was first done in 1569 by Daniello Barbaro of Venice. Ibid. p. 1160.

copying an existing chart and identified three methods: freehand via a grid, tracing, or pounce.[68] Likewise Corradino Astengo discussed the same methods,[69] as did Pujades i Bataller.[70] In the works by all three scholars, two oft-cited documents were discussed. The first has already been mentioned, the *Arte de Navigar* by Martín Cortés, which explained the methods of tracing using a transfer sheet and using the square grid. The second document is Bartolomeo Crescentio's *Nautica Mediterranea,* published in Rome in 1602, which elucidated two other methods: using pounce forced through pinpricks, and direct tracing using the sun as a backlight.[71]

The overall production process described by Cortés has already been summarised, but his reproduction techniques warrant closer examination. He called the first process '*trasflorar*'. A tracing of the hydrography from the exemplar was first made onto transparent linen paper.[72] Then, the tracing was secured above the new chart, making sure N-S and E-W were parallel (presumably this was done with pins or wax). Next, paper that was smoked on one side was placed between the two, with the smoked side down onto the new chart. Using a blunt stylus, the entire hydrography was traced, and the smoke transferred onto the new chart. Finally, after removing the smoked and tracing papers, black ink was drawn over the transfer, and once dry, old bread was used to erase the smoke.

Cortés described a second process, which he called '*quadratura*', that would be used to enlarge or reduce the scale of the chart being copied. A grid of squares was drawn over the exemplar, and a corresponding grid of squares (larger or smaller) on the new chart, and then the coastline was copied freehand. However, there is little evidence of these grids on charts: Astengo noted that only in two unfinished seventeenth century atlases, square grids drawn with lead pencil are visible, independent from the rhumb network and scale, which may have been used to copy the unfinished sheets from their respective exemplars, and he dismissed the square grid technique as unlikely to have been used, given the lack of evidence.[73]

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68 Campbell: (1987), pp. 390-392.

69 Astengo: (2007), pp. 185-186.

70 Pujades i Bataller: (2007), pp. 478-480.

71 Crescentio, Bartolomeo: *Navtica Mediterranea* (Rome: Bartolomeo Bonfadino, 1602). <http://gallica.bnf.fr/ark:/12148/bpt6k51038x/f2.image.r=nautica%20mediterranea.langEN> [accessed 24 January 2013], p. 189.

72 Cortés: (1551), p. 128 (f. 63r). The paper was made transparent by soaking it in linseed oil and allowing it to dry.

73 Astengo: (2007), pp. 185-186.

However, Astengo and other scholars have mistaken Cortés' instructions by assuming the grid was copied directly onto the parchment. *Quadratura* was simply an extra step to the *trasflorar* process described above. Cortes wrote: "avemos de pintar solamente la costa et islas en un papel, dela manera que se pinto en la carta arrumbada. Digo que se pinte en un papel por no estragar los padrones."[74] Although Cortes did not specifically state that one would use the aforementioned *trasflorar* process to transfer the enlarged or reduced pattern onto a chart, his careful differentiation between 'papel' and 'carta' indicated that the *quadratura* step occurred on paper. Given they were only intermediaries in the process, and on paper (which has a low survival rate), it is no surprise there is no direct evidence of this process.

Bartolomeo Crescentio described two processes in his *Nautica Mediterranea*, published in Rome in 1602.[75] The first was to use pounce: hundreds or thousands of small holes would have been punctured along the coastline of the model, indigo powder ('indico ben macinato') would have been forced through these holes onto the new copy, and the coastline drawn. However, the text was ambiguous as to what the model ('sceda' [*sic*: scheda]) was: an exemplar chart, a traced paper copy, or – as Pujades believed – damask cloth.[76] He posited that damask ('damaschini'), though expensive, was the ideal material

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[74] "Proceed to paint only the coast and islands on paper, in the same manner as you did in the ruled chart. I say that one should paint on a paper so as not to destroy the pattern." Cortés: (1551), p. 133 (f. 65v).

[75] Crescentio: (1602), pp. 189-190: "Questo è adunque il modo, che si tiene nel fabricare Geograficamente le carte: però, perche elle hoggidì non si fanno salvo da huomini idioti, basta avvertire che egli si fanno rigando con aghi sottili damaschini, le coste poi mettendo questa sceda pertusata sopra la carta pecorina, in che vogliano fare un'altra nuova spolvizeranno sopra con Indico ben macinato, sola questa polvere è atta à fare questo effetto, doppo con penna sottile si tirano le coste sopra lo spolverizo, overamente mettendo la sceda sopra un tellaretto della grandezza della stessa carta, per il quale passino alcune corde di Leuto, ò Citara dall' uno all' altro lato bene attesate à modo di quadretto, che mostra la figura sopra d'Ibernia, & sopra la sceda mettendo la pecorina sopra che si hà da fare la nuova carta, & immobili l'una e l'altra incontro alla spera del Sole, restando il modello assai trasparente; si disegneranno con sottilissimo lapis le coste, & doppo si tiraranno con inchiostro & penna sottile. Hà da essere la carta di corpo bianca, & niente grassa". Translation: "This then is the manner of geographically fabricating the charts; however, because these days they are not made except by unprofessional men, it must be said that they make them by pricking the coast with fine damask needles, then placing this punctured model above the parchment chart, in wanting to make a new one, powdering above with well-ground indigo: only this dust is able to make this effect; after which they draw the coast above the powder with a fine pen; or alternatively put the model upon a loom the size of the said chart, through which are passed several lute or zither strings from one side to the other, well tensed as the square method, which is shown in the above figure of Hibernia, and above the model place the parchment upon which he has to make the new chart, and immobilise the one and the other encountering the sphere of the sun, rendering the model very transparent; they will draw the coast with a very fine pencil, and after will draw with ink and fine pen. The chart has to be white of body, and never thick."

[76] Pujades i Bataller: (2007), p. 479.

for this method, would have retained it holes for reuse, and could be cut to any size. However, neither damask fabric nor any woven fabric, would be able to retain hundreds of holes: weft and warp yarns, however tightly woven, would slowly return to their natural alignment. Contrary to Pujades' supposition, it would be a very difficult method to use with cloth, and it seems more likely that 'damaschini' referred to the fine needles ('aghi sottili'), normally used for damask embroidery to be used to puncture the model.

If parchment were used instead, one might expect to see pinpricks in survivours, yet no surviving portolan charts have been found exhibiting them.[77] Campbell noted that dividers might make pinpricks too small to be seen, or that holes in parchment might (over time) close up, given the material's elasticity.[78] However, rubbing pounce upon the pinpricked model would cause it to become irreparably covered in the colour of the pounce, explaining why these models do not survive. To use parchment, somehow the coastline would still have had to be traced onto its surface. Thus, a more sensible material would have been oil-soaked linen paper, as Cortés mentioned. Being transparent itself, the coastline of any chosen exemplar could have been traced onto the paper, but instead of then using smoked paper, holes would have been punctured through the tracing, and pounce forced through onto the new chart. The material rigidity of the compressed fibres and glue of paper would allow for the holes to be retained over time, and it is not unsurprising that these pounce-covered models would not survive to the present day.

The second process described by Crescentio was backlit tracing. First, one would have secured the exemplar upon a frame which had sinew strings ("corde di Leuto, ò Citara") criss-crossing from one side to the other. Presumably, although this was not explicit, the strings would have held the exemplar and new chart tightly together, because any empty space between the two sheets of parchment would have blurred the coastline Crescentio specified that the parchment must be white and thin, which would have rendered them transparent with sunlight passing through them, allowing the coast to be traced using lead, charcoal, or after the mid-sixteenth century, possibly graphite. The backlit tracing method was also advocated by the sixteenth-century Dutch cartographer Lucas Janszoon Waghenaer. In his 1584 publication *Spieghel der Zeevaerdt*, he noted in his

[77] Campbell noted that no use-wear pinpricks of any sort have been found on portolan charts, based on the work by P. T. Pelham who examined numerous charts and failed to find any use-wear markings. Campbell: (1987), p. 443 (note 519).

[78] Ibid.

explanation of how to copy a chart: "next you hold the charts on a glass plate against the light so as to be able to trace the chart exactly with a pencil."[79]

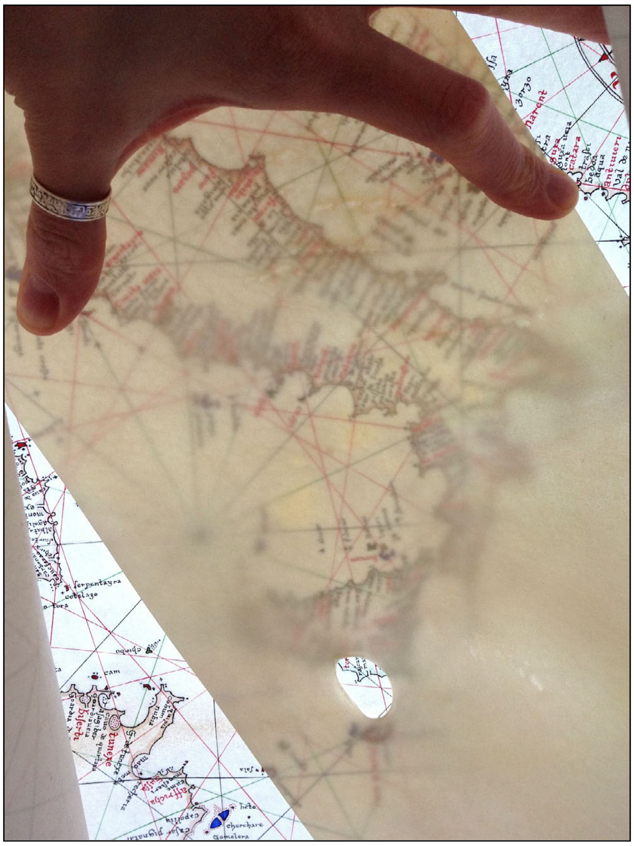

Figure 1.13: Photo of the third reconstructed map (on parchment), with another piece of blank parchment above it, held against a window on a cloudy day, demonstrating its transparency.

Pujades argued the use of pounce to transfer the coastline was the best and probably most often used technique, and questioned whether the backlit method would have been used regularly. He posited that it would have been dependent on weather, required oil-soaked parchment, and that the uprightness of the frame ("incontro alla spera del Sole") would have made the process uncomfortable and unmanageable.[80] However, the arid Mediterranean climate would not have precluded this technique, and as figure 1.13 shows, direct sunlight was not required, nor was 'oil-soaked parchment', which Crescentio never mentioned. In reality, the backlit tracing method, despite needing to be done upright to catch the daylight, might have been one of the simplest and quickest methods, without any need for the intermediate tracing and transferring stages.

The Reconstruction: Copying the Coastline

Because the above examination of the four techniques revealed that three of them might have involved the use of oil-soaked paper 'models,' the reconstruction experiment tested the use of this tracing paper, along with the *trasflorar* method Cortés described. Crescentio's method of backlit tracing was also briefly tested.

[79] Koeman, C.: 'Lucas Janszoon Waghenaer: A Sixteenth Century Marine Cartographer', *The Geographical Journal*, 131: 2 (1965), 202-212. p. 205.

[80] Pujades i Bataller: (2007), p. 479.

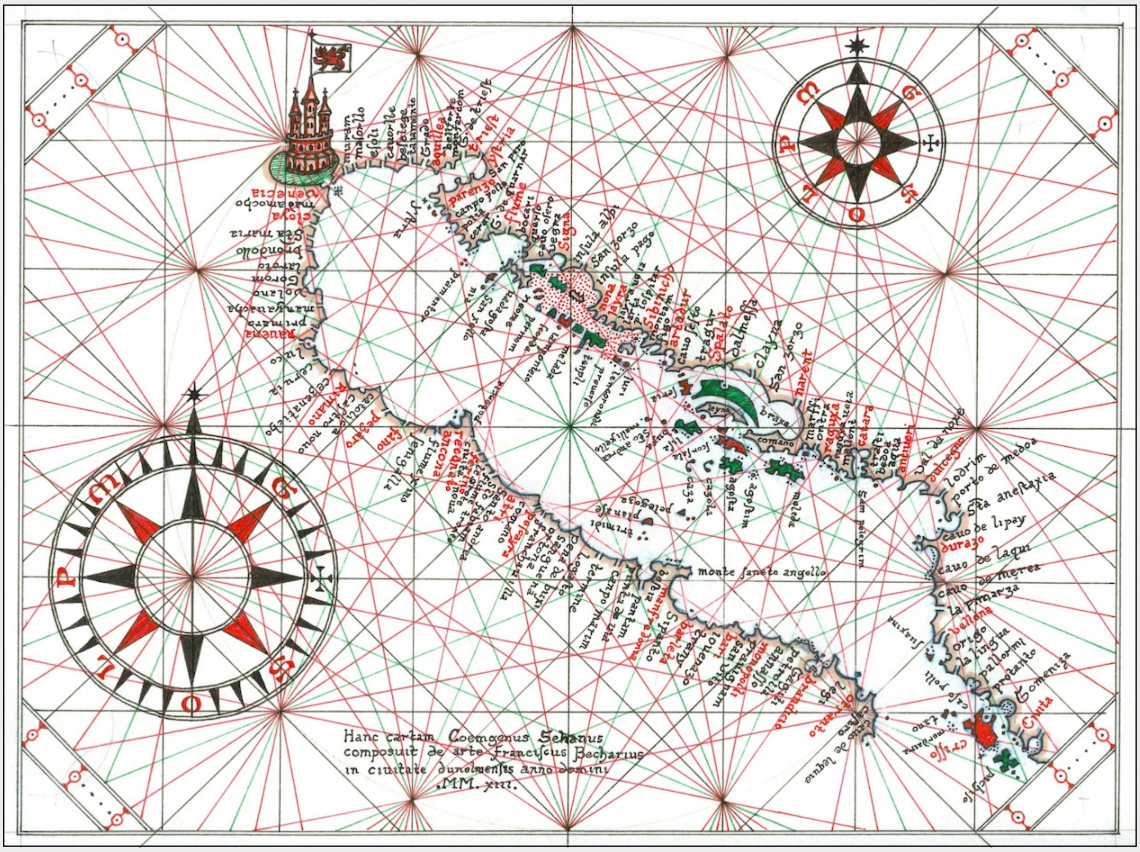

Figure 1.14: The first reconstructed map, on paper and using modern materials.

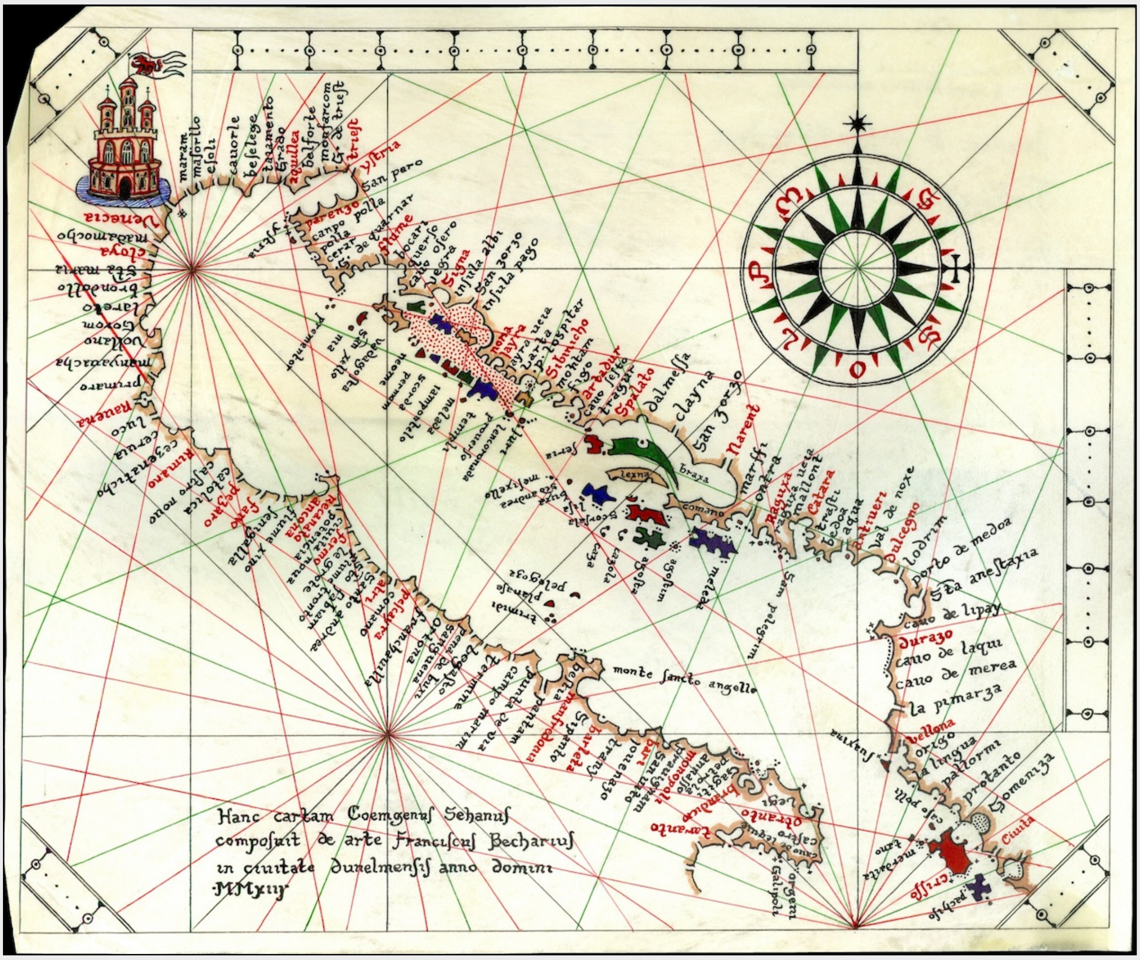

Figure 1.15: The second reconstructed map, on parchment and using traditional materials.

Figure 1.16: The third reconstructed map, on parchment and using traditional materials.

The *trasflorar* process was used to make three reconstructions: the first (figure 1.14) was of the Adriatic Sea, on paper, using modern materials. The second (figure 1.15) was again of the Adriatic, but on parchment, using (as far as possible) medieval materials. The third (figure 1.16) was again on parchment, using medieval materials, and comprised the western Mediterranean Sea from Gibraltar to just east of Rhodes.

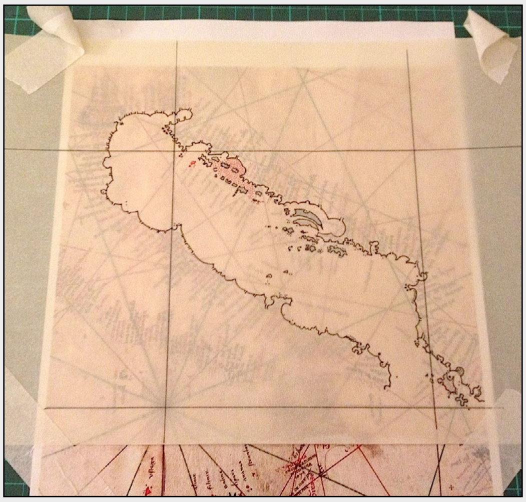

Figure 1.17: 95gsm 'Goldline' sketch paper.

Figure 1.18: 40-50gsm 'Old Master Translucent' linen/cotton paper.

Four different types of paper were brushed with linseed oil and allowed to dry to test how well they would work according to Cortés' description. The 95gsm 'Goldline' sketch paper (modern) took the linseed oil very well, becoming transparent enough to see the exemplar underneath, but ripped easily when pressed with the stylus. The 320gsm 'Arches' watercolour paper (modern) never became translucent enough to be useful. The 40-50gsm 'Old Master Translucent' linen and cotton rag paper (figure 1.18) was thin enough to nearly see the coastline below without oil, and was perfectly transparent when oiled.[81]

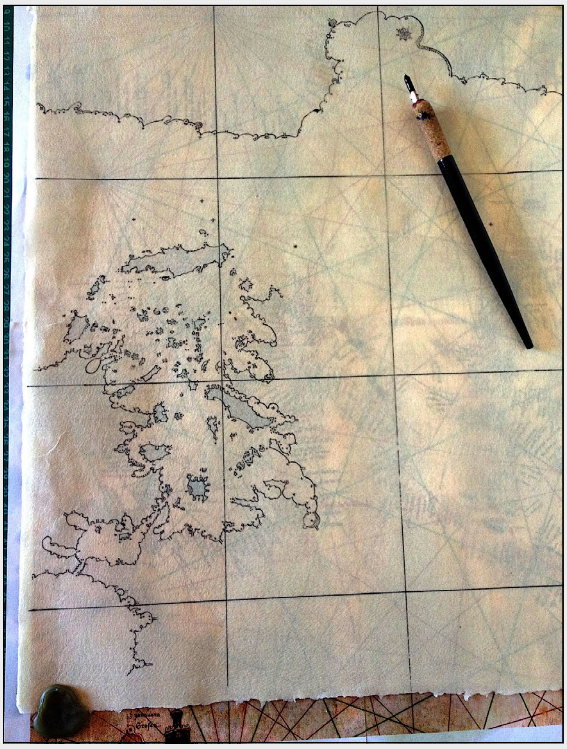

Figure 1.19: 90gsm 'Old Master Rideau' linen/cotton paper.

[81] Both the 'Old Master' papers were bought from Shepherds London, and were created using early modern paper-making techniques.

Fears it would rip when the stylus was used were unfounded; the paper was quite strong and performed exceedingly well. Finally, the 90gsm 'Old Master Rideau' linen/cotton rag paper, while less transparent than the 40-50gsm paper, was acceptably translucent to be used to trace the coastline from the map beneath it when brushed with oil.

From the experimentation, linen rag paper, commonly available in late-medieval and early-modern Europe, was ideal for the tracing process: sturdier than modern wood-pulp paper, it could be made thin enough to become completely transparent when oiled, making tracing a straightforward process. The table below shows the times it took to trace the coastlines.

No.	*Paper / Materials*	*Coverage*	*Topo-nyms**	*Time*	*Length/ Time*
1	95gsm 'Goldline', ballpoint pen	Adriatic (Otranto - Corfu)	170	29m:44s	10.5s/tn
2	95gsm 'Goldline', dip pen & ink	Adriatic (Taranto - Corfu)	176	22m:35s	7.7s/tn
3	40-50gsm 'Old Master translucent', dip pen & ink	Western Mediterranean (Seville - Amantea, Tangier - Tripoli)	564	1h:45m: 34s	11.2s/tn
4	90gsm 'Old Master Rideau', dip pen & ink	Eastern Mediterranean (Sorrento - Varna, Kandira - Fethiye, Sfax - Mersa)	691	2h:44m: 21s	14.3s/tn

* Because it is considerably difficult to measure the actual length of a drawn coastline, the length is instead given as the number of toponyms, which were (for the most part) fairly regularly spaced around the coastline.

The above table indicates that it took approximately 10-15 seconds per toponym to trace the coastline of a portolan chart, averaged across the entire geography. Areas such as the Aegean sea were considerably more complicated, and took more time than more straightforward coastlines such as the African Mediterranean. Additionally, it was found that it was unnecessary to trace any fields of

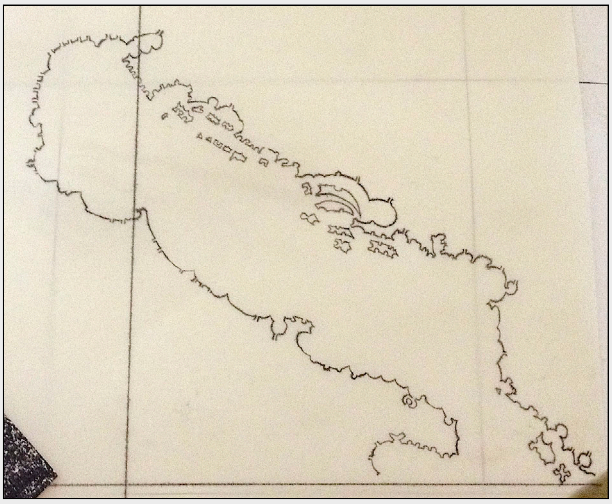

Figure 1.20: The second tracing of the Adriatic Sea, ignoring all the small dots around the coast.

dots around the coast, or to differentiate the tracings in red or black ink, because the exemplar would be available for reference when drawing the coastline later.[82]

Details concerning the smoked paper were unspecific: Cortés wrote only that it was "smoked with tea or with wicks of pitch."[83] Determining the method by which to obtain paper smoked on one side was a matter of trial and error, but it was found that holding the linen paper about 5cm above a lit candle, and quickly flicking an iron wire through the flame caused thick black smoke to rise from the flame and cover the paper, the results of which can be seen in figure 1.21.[84]

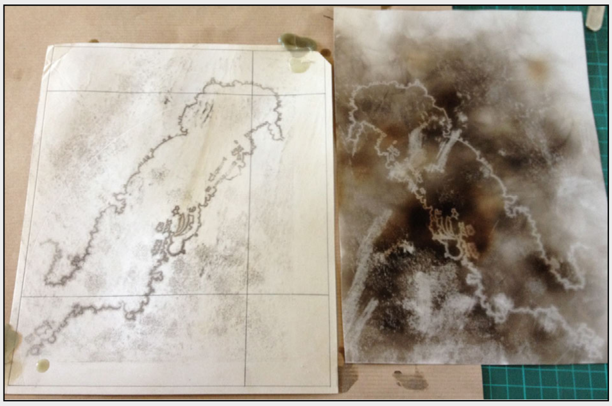

Figure 1.21: The smoked paper (right) and its transfer onto the parchment (left) of the second reconstructed map.

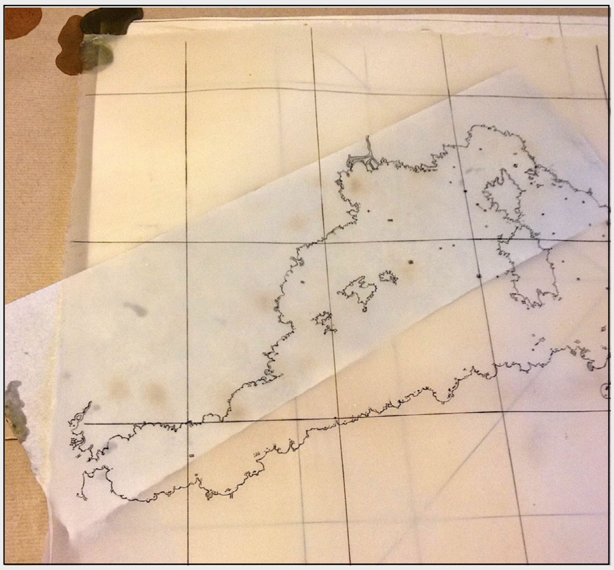

Figure 1.22: The placement of a sheet of smoked transfer paper between the tracing (above) and the parchment (below), which have been aligned using the grid and held secure with wax.

The smoked paper was placed between the tracing and the new chart, and the entire coastline was imprinted using a blunted stylus. It was found the smoked paper could be used multiple times, simply positioned and repositioned for each stretch of the littoral.

The following table indicates the times it took to transfer the coastline for each experimental chart.

[82] This was also the reason for the temporal difference between the first tracing (figure 1.17) and second tracing (figure 1.20), both of the same stretch of coastline in the Adriatic.

[83] Personal translation. Original text: "El qual se aya a huma -|do contea o con mechas de pez." Cortés: (1551) f. 63v.

[84] Presumably smoking paper in this or a similar manner was a task that was left to an apprentice within the cartographer's atelier, thus the time it took to make this paper was not counted in the totals for the experiment.

No.	Materials	Coverage	Topo-nyms*	Time	Length/ Time
1	95gsm 'Goldline' tracing, onto modern card using modern carbon transfer paper	Adriatic (Otranto - Corfu)	170	11m:13s	4.0s/tn
2	95gsm 'Goldline' tracing onto parchment using smoked paper	Adriatic (Taranto - Corfu)	176	9m:11s	3.1s/tn
3	40-50gsm 'Old Master translucent' & 90gsm 'Old Master Rideau' onto parchment using smoked paper	Mediterranean (Seville - Varna, Kandira - Fethiye, Tangier - Mersa)	1208	2h:08m: 14s	6.4s/tn
* As above, because it is considerably difficult to measure the length of a drawn coastline, the length is instead given as the number of toponyms.					

The table indicates that the imprinting process took less time than the initial tracing. The extra time in the third experiment was due again to the numerous islands in the Aegean sea, which were more complex than the rest of the hydrography. Furthermore, all three types of tracing paper withstood the imprinting from the stylus, and could be used to imprint multiple copies. Figure 1.23 depicts the results of the transfer process for the third reconstructed map.

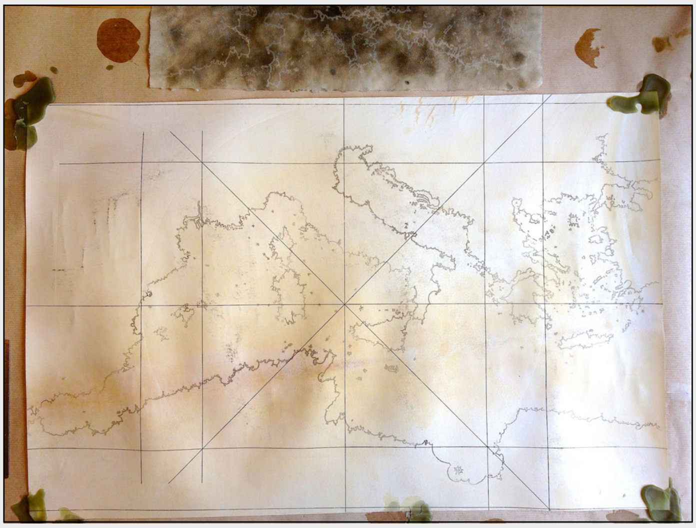

Figure 1.23: The transferred smoke outline on the parchment of the third reconstruction. The smoked paper used to make the transfer can be seen at the top.

Figure 1.24: Drawing over the smoke-transferred coastline with black ink, using the exemplar as a guide when necessary.

Once the hydrography was transferred, black ink was used to trace along the coast, using the exemplar as a guide. All red dots representing sandy shoals were left to insert at the same time as the red toponyms were written; it was not likely that chart-makers would have switched between quills or inks throughout the process. The following table shows the times it took to draw the hydrography over the smoked transfers:

No.	*Materials*	*Coverage*	*Topo-nyms**	*Time*	*Length/ Time*
1	Modern card, ballpoint pen	Adriatic (Otranto - Corfu)	170	26m:21s	9.3s/tn
2	Parchment, dip pen & ink	Adriatic (Taranto - Corfu)	176	21m:19s	7.3s/tn
3	Parchment, dip pen & ink	Mediterranean (Seville - Varna, Kandira - Fethiye, Tangier - Mersa)	1208	5h:21m: 49s	16.0s/tn

* As above, because it is considerably difficult to measure the length of a drawn coastline, the length is instead given as the number of toponyms.

The table demonstrates the variability in time drawing the coastline could take: the third reconstruction took longer per toponym because the Adriatic has a relatively simple hydrography, especially when compared to the Aegean. Although not every small dot was traced or transferred, every dot and small island had to be correctly drawn and placed on the final copy, using the exemplar as a guide. Once the coastline was copied, the smoke was erased. Cortés recommended using crusts of old bread, which worked well.

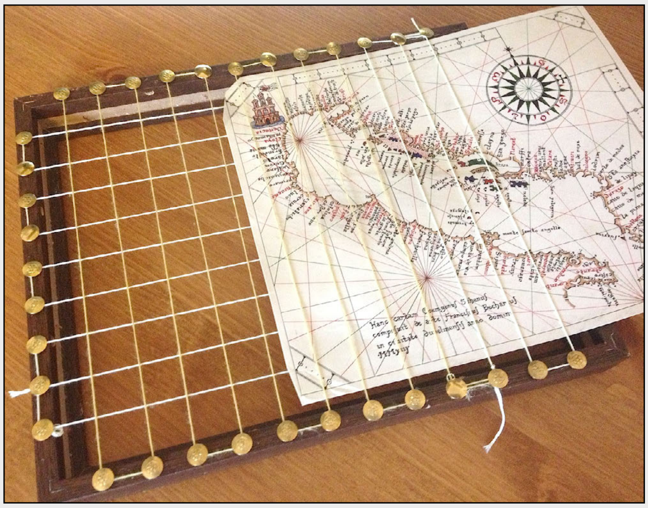

Figure 1.25: An example of a scaled-down frame described by Bartolomeo Crescentio. The second reconstructed map is shown sliding between the perpendicular strings.

While the three full map reconstructions were completed in order to test Cortés' *trasflorar* method, it was thought prudent to briefly investigate Crescentio's method of backlit tracing. Figure 1.25 shows a scaled-down version of the frame Crescentio described. Regularly-spaced cords would have been tightly strung in one direction, then more strings placed above perpendicular to those below. The two sheets of parchment would then be slid between the strings, which held them together. Although the pictured model used embroidery thread strung around regularly-spaced pushpins on a wooden picture frame, a larger model as Crescentio intended would have used catgut cords, which probably could have been tightened on pegs in the same manner as musical instruments. The intent was to secure the parchments and keep them flat against each other aiding the clarity of their transparency. The strings would also have provided a firm back to counter the force of the tracing. Even the simple model pictured, held against a window on a cloudy day (not in direct sunlight) and using parchment that was far from 'white and thin', demonstrates the viability of this method for tracing.

Figure 1.26: The second reconstruction on parchment (behind), with a blank piece of parchment (front) placed inside of the frame, and held in front of a window on a cloudy day.

Figure 1.27: A tracing of the coastline directly from exemplar to copy using Crescentio's frame.

A test tracing of the coastline of the Adriatic, using a piece of artists' charcoal and the second reconstruction as the exemplar, took only 12m:12s to complete. This was only 38% of the time it took to use Cortés' method (31m:46s), and achieved an equally precise tracing of the hydrography.

The hydrography of most portolan charts is generally characterised by exaggerated coastlines, with overly prominent headlands and concave bays. A casual look at nearly any of the charts reveals that the coastlines were exaggerated and simplified into more geometric shapes and curves. An example can be seen in figure 1.28, which depicts the Sea of Marmara, with the relevant coastline from the 1468 Benincasa atlas superimposed upon it. The accuracy of the hydrography, its change over time, and the impact this has on the chart's function will be discussed in detail in Chapter IV, but warrants some discussion with regard to the reconstruction.

Campbell, in his 1987 chapter, discussed the conventions of portolan chart hydrography, and wrote that islands and capes were enlarged because of their navigational significance: headlands were conventionalised into points, circles, and wedges, and the coasts between headlands simplified into regular geometric arcs.[85] On his MapHist website, Campbell continued to discuss these hydrographic aspects with particular reference to the shape of small and medium-sized islands, which were either drawn as basic geometrical shapes (triangles, squares etc.) or highly exaggerated. One of the most notable was the Aegean island of Limnos, shown in figure 1.29. His overall conclusion was that the hyperbolic (and inaccurate) forms of the islands might not be navigationally useful, but instead serve as mnemonic devices to aid a navigator in remembering each island's hydrography through former learned experience.[86]

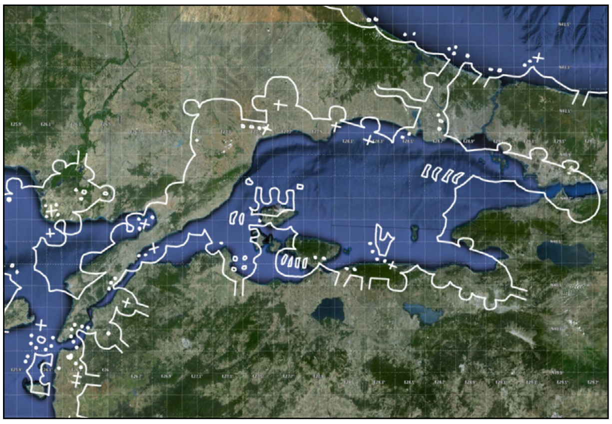

Figure 1.28: A Google Earth™ map of the Sea of Marmora with a superimposition of the same coastline digitally traced from the 1468 Benincasa atlas.

Figure 1.29: The Aegean island of Limnos depicted on the 1489 Albinus da Canepa chart. Image courtesy of: Minneapolis: JFBL, B1489mCa.

However, Peter Pelham suggested that the exaggeration of the hydrography was a result of the copying process. Pelham argued that the use of Crescentio's pounce method would naturally result in the over-prominence of the headlands, and the simplification of bays

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85 Campbell: (1987), p. 377.

86 Campbell, Tony: 'Explanatory notes and wider implications of 'The colours and shapes used to denote some of the smaller islands and the major estuaries on portolan charts up to 1500'', (2011) <http://www.maphistory.info/PortolanColourNotes.html> [accessed 31 January 2013].

into simple geometric curves, because the chart-maker was essentially connecting dots.[87] The reconstruction, using the *trasflorar* process, resulted in the same; when using the stylus to impress the traced coastline onto the new map, the natural inclination was to simplify curves, and highlight notable forms. Additionally, the transferred lines of smoke were between 1 and 2 mm thick, hardly precise, and when these were drawn over in ink, the same occurred.

Using a square grid method to copy by sight would have proved less accurate, and while the backlit tracing method might have been the easiest to replicate faithfully, it would have depended on how slowly and diligently the tracing was made, and the fineness of the lead or charcoal tip. Assuming that portolan charts were copies of copies, and not generated anew from spatial data,[88] by the hundredth generation, the copy could be grossly morphed from its original, more accurate form. Thus, it was not by choice that the portolan charts were exaggerated hydrographically, but instead a result of the copying techniques employed.

The method used to transfer the hydrography from the exemplar to the new map was undoubtedly the most important step in the construction of a portolan chart. Although only a cursory examination, Crescentio's backlit tracing method was the fastest technique of those tested, and it seems likely it would also have been faster than pouncing and the square grid method. Backlit tracing also had the advantage of only involving a single iteration of copying, resulting in less potential for the introduction of errors, whereas *trasflorar* would involve two (a copy of a copy), as would pouncing. Nevertheless, the *trasflorar* method worked well, and was a perfectly plausible technique. Indeed, it was likely all four copying techniques were employed by different chart-makers, and certainly the square grid method was the only one with the ability to rescale the map size.

In discussing these processes, Pujades – referring to Cortés' description, but equally applicable to Crescentio's – warned that "to blindly accept that this was exactly the way medieval cartographers worked in their ateliers would be dangerously ill-advised."[89] Naturally, chart-makers would have used whatever process they were taught or devised, and

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[87] Pelham, Peter Thomas: 'The Portolan Charts: Their construction and use in the light of contemporary techniques of marine survey and navigation' (Unpublished MA Thesis, Victoria University, 1980). pp. 90-91.

[88] There is little evidence to suggest that every chart-maker produced his exempla from spatial data; it is far more likely that charts were copied from one another. The hydrographic comparisons in Chapter III will confirm this likelihood.

[89] Pujades i Bataller: (2007), p. 472.

with which they were most familiar. However, before the revolution of printing and later reproduction techniques that developed in the eighteenth and nineteenth centuries, there were only a few ways that one could copy a map (or any image) manually.

Adding the Toponyms

Once the hydrography had been copied to the new chart, the toponyms could be added. There is some evidence that the rhumb network may have been left until after the toponyms were copied,[90] but most indications are that the rhumb line network was completed first. Not only has electron microscopy shown this,[91] but on most of the portolan charts and atlases there are instances where a toponym was written slightly askew, in order to dodge a rhumb line, or if across a rhumb, instances where two adjacent letters were written definitively to either side of a line, leaving what would be a conspicuous gap had the rhumb not been there, as shown in figure 1.30. However, this is not to say that there

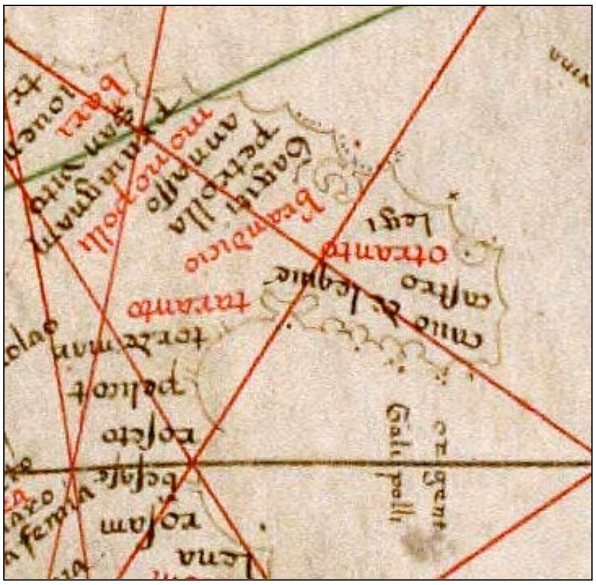

Figure 1.30: Southern Italy near Taranto, as depicted on the 1403 Franciscus Becharius chart. '*Galipolli*' and '*orgent*' have clearly been written after the black line running through them. '*Brandicio*' had also probably been written after the red rhumb line. Image courtesy of: New Haven: BRBML, Art Storage 1980.158.

Figure 1.31: Calabria, as depicted on the 1489 Albinus da Canepa chart. The red toponym '*lamantea*' had to be squeezed into the little space available, and the final 'a' appears to be above the black toponym '*trebesaze*', while '*garazo*' had to be written over two lines. Image from: Minneapolis: JFBL, B1489mCa.

[90] Pujades discussed portolan charts with only the black rhumbs drawn, but with the coastline and black toponyms copied. See section on Rhumb Lines above. Ibid. pp. 189, 473.

[91] Tony Campbell examined four charts at the British Library, confirming that the rhumb lines were underneath both the coastline and the toponyms in three maps. Campbell: (1987), pp. 390-391.

was an established rule chart-makers followed: some makers may have written toponyms after the black rhumbs, but before the red and green rhumbs. For clarity, it would seem logical to have completed the rhumb network first so that the toponyms could be written around them.

The toponyms were always written with the first letter next to whatever aspect of the hydrography it referred. The same applied for islands: the first letter of any label was next to its geographical location. For the southern European coastline, the names were written inward from the coast, beginning in the west, and circling to the east. The opposite happened on the Mediterranean African coastline, where the toponyms were written beginning in the east and ending in the west.

Whether the red or the black toponyms were written first, or if they were both written concurrently, is less definitive. Some chart-makers clearly wrote the black place-names first, as evidenced by instances where a red toponym was squeezed into a space, or where the red ink appears clearly above the black of a different name. Both of these instances can be seen in figure 1.31. However, other charts have depicted the opposite as shown in figure 1.32 where the black '*cauo de martim*' had to be placed around the red '*denia*', which therefore must have been written first. One might imagine that it would have been easier to write the red place-names first, because they were fewer in number, and could serve as visual place-markers, but as with other aspects of construction, different chart-makers seem have proceeded in whichever way they were trained or most comfortable.

Figure 1.32: The coast of Spain near Valencia, as depicted on the 1403 Franciscus Becharius chart, where '*cauo de martim*' has clearly been written after '*denia*'. Image from: New Haven: BRBML, 1980.158.

The Reconstruction: Adding the Toponyms

In the three experimental constructions, the toponyms were written only after the entire rhumb network had been completed, and on all three, the red ones were written first, followed by the black ones. The place-names were copied by reading the exemplar, taking note of where exactly the toponym was placed, and then copying it on the new chart. Copying began in the west in Iberia, and the toponyms were written one after another working towards the Black Sea, then from Africa back across to the Strait of Gibraltar. Then the red island toponyms were written, again working generally from west to east, and north to south, with the intention that the writing hand did not smudge any still wet ink. While writing the red toponyms, all small red dots – representing sandy shoals – were drawn in. Once the red toponyms had been finished, the black names were written, following the same pattern.

The following table shows the time it took to copy the toponyms from the exemplar to the new chart in the three experimental reconstructions.

No.	***Materials***	***Coverage***	***Red Toponyms*** / ***Black Toponyms***	***Time***	***Time / Toponym***
1	Modern card, ballpoint pen	Adriatic	37	18m:01s	29.2s/tn
			133	58m:55s	26.6s/tn
2	Parchment, dip pen & ink	Adriatic	38	22m:28s	35.5s/tn
			138	1h:03m:08s	27.5s/tn
3	Parchment, dip pen & ink	Mediterranean	216	3h:17m:34s	54.9s/tn
			992	9h:01m:26s	32.7s/tn

The results shown in this table demonstrate that the writing of the toponyms was the most time consuming stage of portolan chart reconstruction, taking 25-40 seconds per toponym. The result for the red names in the third reconstruction can be explained both by the fact that areas of red dots (sandy shoals) were added at the same time (an example of which is shown in figure 1.33), and that there were two mistakes made (placing the toponym in the wrong place) which had to be erased and rewritten. The extra time it took to write the red toponyms in all three reconstructions was due to the fact that they had to be positioned correctly on the coastline, with no reference other than the

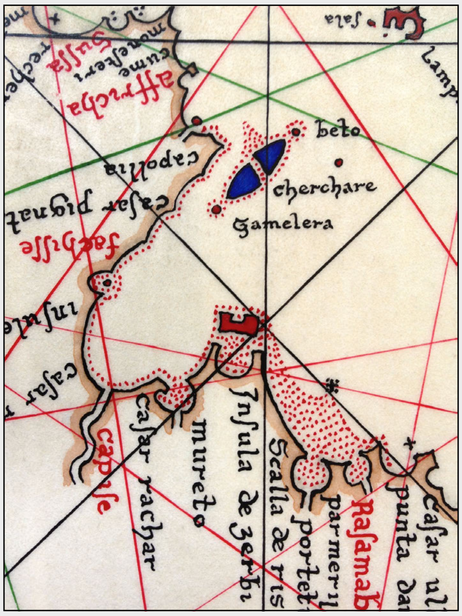

Figure 1.33: Considerable numbers of red dots around the Tunisian Gulf of Gabes. From the third reconstructed portolan chart.

coast, whereas the black toponyms were more easily positioned between two sequential reds which served as reference points.

The copying of the toponyms in the reconstructions revealed interesting observations about the formation and imitation of letter forms, the spelling of words, and the orientation and placement of those words. Although there was no specific intention of replicating the calligraphy from Becharius' exemplar, when copying the toponyms, it felt natural to write many letters the same. For instance, the italic curved 'd', the 'h' with a final descender below the line, and the italic 'z' which looks like the number '3' were unintentionally mimicked. A fork was also placed atop the 'b', without second thought. Conversely, the letters 'a' and 'r' were drawn completely different to the exemplar, and despite the specific intention not to do so, the occasional letter 'i' was given a tittle. Moreover, unconsciously, when a letter was capitalised in the exemplar, it was capitalised in the copy. Medieval scribes did sometimes mimic the calligraphy of whomever they were copying, but this experiment demonstrates that perhaps this happened more unconsciously than is generally believed.

Even more variable between the exemplar and copy were the spellings of the words. From the outset of the reconstruction, there was a clear intention to copy the spelling exactly as it was in the exemplar. However, it became apparent that the method of copying resulted in slight misspellings. For example, the Apulian town of Monopoli was spelled '*monopolli*' on the Becharius chart, the double 'l' of which was copied on the first and third reconstructions, but misspelt with a single 'l' on the second. There were numerous other instances of misspellings, usually occurring between double/single letters, and similar-sounding and similar-looking letters, such as 'm' and 'n'. The reason quickly became apparent: the word was read from the exemplar, spoken internally, and then written on the copy as the mind heard the word spoken, rather than seeing it written.

Although letter shape and the spelling of words might vary, the reconstruction demonstrated that the orientation of toponyms was not easily modified; i.e. the direction of a name from the geography it labelled remained the same. Whereas on the mainland, most toponyms were written inland perpendicular to the coastline, there were some toponyms that were written in the sea. An example are the toponyms '*Galipolli*' and '*orgenti*' off the heel of Italy, as shown in figures 1.34 and 1.35. On nearly all charts, these toponyms were labelled in the sea: although space did not allow for all names to be written inland, a chart-maker might have had space to write both inland if he labelled '*cauo de lequie*' in the sea instead. However, this did not happen; although convention is one explanation, another is that when a chart-maker was copying, it was not worth the time to alter a word orientation that already worked. '*Galipolli*' and '*orgenti*' would not have been written at the same time as '*cauo de lequie*' and '*castro*', but later when the islands were labelled, because the chart would have had to be turned around, and the wet ink from previous toponyms might have been smudged.

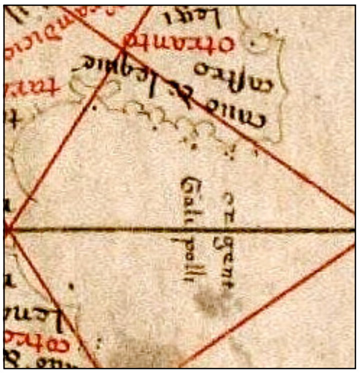

Figure 1.34: '*Galipolli*' and '*orgent*' on the 1403 Franciscus Becharius chart. Image from: New Haven: BRBML, Art Storage 1980.158.

Figure 1.35: '*Gallipolli*' and '*orgenti*' depicted on the third reconstruction.

Figure 1.36: '*Uegra*', '*insula albi*' and '*insula pago*' from the third reconstruction.

Another example of this conventionalism of copying was the treatment of three islands in the north Adriatic: '*uegra*', '*albi*', and '*pago*' which correspond to the three modern islands: Krk, Rab, and Pag respectively. From the 1330 Dulceti chart onwards, the toponyms were on land, as shown in figure 1.36, probably because there was no room to write them in the sea. Whereas on some charts '*albi*' and '*pago*' included '*insula*' to inform the reader that these place-names refer to islands, '*uegra*' more often did not. This would seem to indicate that most chart-makers practised straightforward copying, without critical thought about how places were being labelled: once an exemplar had labelled something in a particular way, few sought to change what was then established.

Distance Scales

The final major stage in creating a portolan chart was the addition of distance scales, and from the early sixteenth century onwards, latitude scales. While the earliest surviving charts provided scales in various forms (see figures 1.37 and 1.38), the 1318 Petrus Vesconte atlas depicted a scale bar that would become the standard for all later portolan charts, as depicted in figure 1.39.

Figure 1.37: The scale depicted on the c.1290 *Carte Pisane*. Image from: Pujades i Bataller (2007) DVD Supplement.

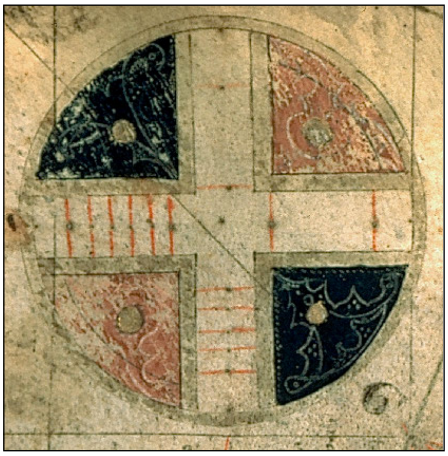

Figure 1.38 (above): The scale from the 1313 Petrus Vesconte atlas (f. 5v.) Image from: Pujades i Bataller (2007) DVD Supplement.

Figure 1.39 (right): The scale depicted on the 1318 Petrus Vesconte atlas (f. 3v). Image from: Pujades i Bataller (2007) DVD Supplement.

Two distances were measured on these scales: leagues and *miglia* (also known as *millaria* or *mia*). Cortés indicated that the distance between each line was 12.5 leagues.[92] Giovanni da Carignano wrote on his c.1327 portolan chart: "Nota quod quodlibet spacium denotat milaria decem, maius spacium denotat milaria quinquaginta et hec mensura … per mare licet non in omnibus per terram propter vias tortuosas".[93] Jehuda Abenzara wrote on his 1505 chart: "li punti nigri deluno al altro sissono .10. mile; li punti Rosi daluno al altro sino .50. mi--".[94] Thus, the space between each dot was 2.5 leagues, which equalled ten *miglia*.

[92] Cortés: (1551), pp. 130-131 (ff. 64v-64r).

[93] "Note that each space denotes ten *milaria*, the large space denotes fifty *milaria*, and this measure … through the sea is not in all ways the same as through land on account of crooked ways." Latin transcription in: Nordenskiöld, A. E.: *Periplus: An Essay on the Early History of Charts and Sailing-Directions*, trans. by Francis A. Bather (Stockholm: P.A. Norstedt, 1897; repr. New York: Burt Franklin, 1964). p. 22. Unfortunately the da Carignano map, which had been housed at the Florence State Archives was destroyed during WWII, though a monochrome reconstruction exists based on photos.

[94] "The black dots from one to another are 10 miles; the red dots from one to another are 50 miles". Abenzara, Jehuda (1505): New Haven: BRBML, 30cea/1505.

The modern distance of *miglia*, and Cortés' league are still matters of debate. Nordenskiöld, one of the first scholars to study portolan charts, through a series of measurements and calculations, arrived at a figure of 5.83 km for what he dubbed the 'portolan-mile', which was five *miglia*. He claimed that his 'portolan-mile' equalled the length of a Catalan '*legua*' as discussed by Spanish historian Ioannis Mariana in *De ponderibus et mensuris* (1611).[95] Nordenskiöld's calculations however, were unscientific; the medieval 'league' was poorly defined, and his discussion of scale seemed skewed to fit his hypothesis of a Catalan origin for the genre.[96] Nordenskiöld additionally became confused by several charts that seemed to show that his 'portolan mile' (synonymous to a league according to his calculations, but not according to Cortés) equalled four *miglia* instead of five. Unfortunately Nordenskiöld was not aware of Cortés' explanation.

Other scholars have attempted, through cartometric measurements, to better determine the length of *miglia*. Wagner and Steger calculated an average distance of 1.25 km per *miglia* for the Mediterranean, and 1.48 km (nearer the traditional Roman mile) for the Atlantic coastlines.[97] Cortesão calculated a distance of 1.33 km per *miglia* on the 1424 Pizzigano chart of the Atlantic.[98] Campbell noted that the majority of scholars had accepted an approximate value of 1.25 km, but that the distance varied depending on location and the issue remained unsettled.[99] Pujades (2007) provided tables of 110 charts and atlases from which he took five distance measurements each, and the length of the 50-*miglia* scale markings.[100] Pujades' objective was only to determine if there were patterns in the scale of each map, and he did not use the data to calculate averages for the distance of a *miglia*. However, this cartometric information was used to calculate the lengths of *miglia* from each map.[101] The results indicated that the majority opinion to which Campbell referred – roughly 1.25 km per *miglia* – is correct. However, this result was only an average: the calculations revealed a significant variation of between 0.833 km to 1.891 km per

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[95] Nordenskiöld: (1964), pp. 22-24.

[96] These concerns were also echoed by: Kelley Jr., James E.: *On Old Nautical Charts and Sailing Directions: Technical Essays* (Melrose Park, PA: Sometime Publishers, 1999). pp. 84-85, and Campbell: (1987), p. 389.

[97] Kelley Jr.: (1999), p. 85.

[98] Cortesão, Armando: 'The North Atlantic Nautical Chart of 1424', *Imago Mundi*, 10 (1953), 1-13. p. 2.

[99] Campbell: (1987), p. 389.

[100] Pujades i Bataller: (2007), pp. 204-209.

[101] This data is presented in Appendix I.

miglia: 67% and 152% of the correct value respectively. The implications of these inconsistencies of scale are discussed in greater detail in Chapter IV.

The Reconstruction: Distance Scales

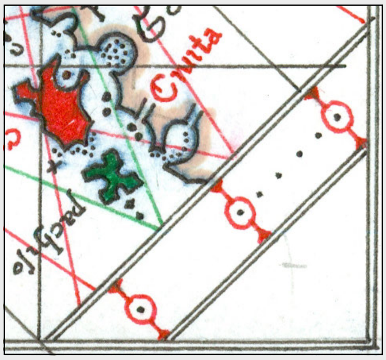

Figure 1.40 (above): A scale from the first reconstruction.

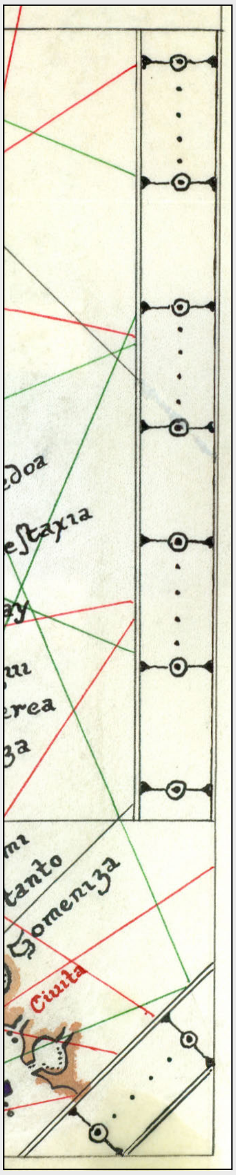

Figure 1.41 (left): Scales from the second reconstruction.

Figure 1.42: Scales from the third reconstruction.

Experimentation indicated that the areas in which the scales would be drawn necessitated demarcation before the rhumb line network was completed, despite Cortés recommendation to add the scales at the end of production.[102]

For the first reconstruction, only corner scales of the type popularly used in atlases were added (figure 1.40), which took 17m:21s to draw. The second reconstruction featured both four corner and two longer scales (figure 1.41), which took 33m:17s to draw. The third reconstruction featured three long scales, two of which are seen in figure 4.42, which took 1h: 15m:09s to draw.

The method used to draw the scales was – as Cortés suggested – to use the dividers to measure the length of eight fifty-*miglia* divisions from the exemplar (equalling 100 leagues according to Cortés), and transfer this length to the copy.[103] However, it was found that the length could vary by up to a few

[102] Pujades noted an unfinished chart which had completed scales without a coastline, and concluded that the boundary lines of the scale were added at the beginning, with subdivisions added later. See: Ibid. p. 481.

[103] Cortés: (1551), pp. 130-131 (ff. 64v-64r).

millimetres depending on which lines were measured on the exemplar. Measurements were thus taken from as many equal lengths of eight divisions as possible, using an averaged measurement, though it is unknown whether the chart-makers would have been so careful. Subdivisions were then made using the 'crossed-arcs' process discussed earlier. Once the first eight divisions had been made, additional 50-*miglia* points were measured out to fill the area designated for the scale. Dots of black ink were added for each 50-*miglia* division, and alternate dots for the 10-*miglia* subdivisions were added by sight, rather than measurement.[104]

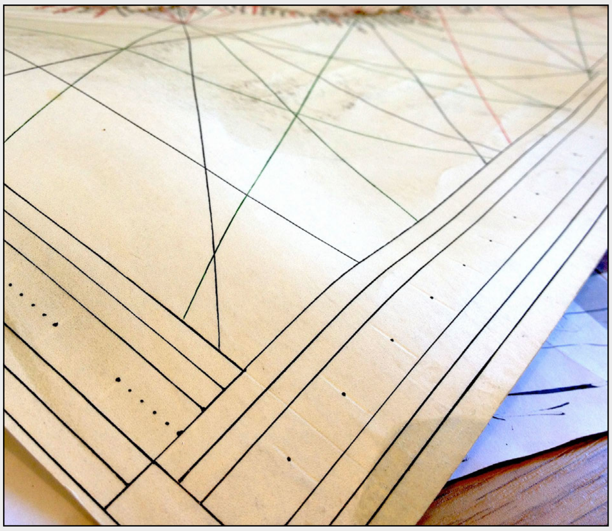

Figure 1.43: Drawing the scales from the third reconstruction, showing the impression left by the use of the dividers to measure out each 50-*miglia* distance.

Alternative methods might have been employed for the scale drawing: chart-makers might have used ruled straightedges, or employed the *trasflorar* process, to transfer the original scale from the exemplar. What is intriguing however, is the fact that many scales were inaccurate, not only in the length of the *miglia*, but in their drawing. Nordenskiöld recognised that the scales were inexact in comparison to the near-perfection of the rhumb network.[105] The perpendicular lines of the divisions appear hand-drawn on most, and the dots often are not in a straight line, as exemplified in figures 1.44, 1.45 and 1.46. The scale from the luxurious and expensive 1439 Valseca chart, although lavishly decorated, is entirely imprecise in its lengths. While accuracy might not have been necessary for a luxury map, it seems improbable that chart-makers would have hastily drawn imprecise scales on their expensive charts, yet take care for accuracy on their utilitarian ones. Why were scales not drawn as accurately as possible? The impression derived is that precision was not terribly important, which negates their functional utility.

[104] On most portolan charts, the 10-*miglia* subdivision dots are so imprecise that one can assume most chart-makers did not measure the distance, but added them freehand.

[105] Nordenskiöld: (1964), p. 21.

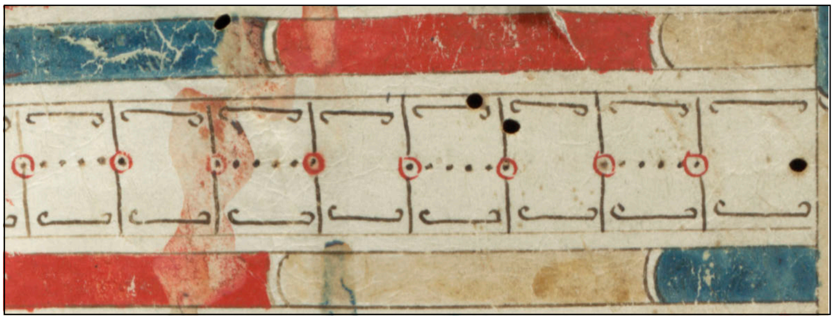

Figure 1.44: The scale from the 1489 Albinus de Canepa chart, which, although heavily decorated, is not precisely drawn. Image courtesy of: Minneapolis: JFBL, B1489mCa.

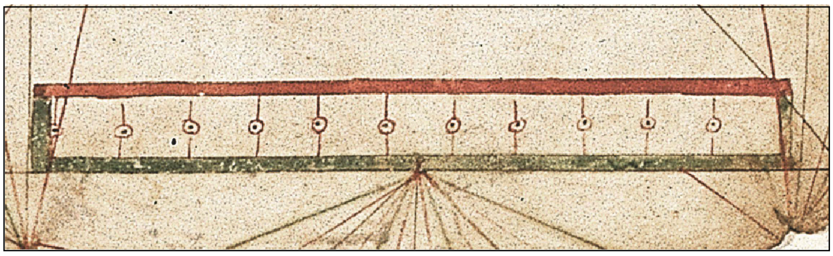

Figure 1.45: The scale from an incomplete and anonymous 15th-century chart, showing imprecision in its form. Image from: Pujades i Bataller (2007) DVD Supplement.

Figure 1.46: The scale from the 1439 Valseca chart, which appears quite inaccurately drawn. Image: Pujades i Bataller (2007) DVD Supplement.

Latitude Scales

Because none of the reconstructed charts extended into the Atlantic, no attempt was made to draw a scale of latitude, but it is still worth discussion. The earliest map to depict latitude scales concurrent with the production of the chart was the 1514/15 Atlantic chart by Ottemanno Freducci.[106] However, a recent study by Lepore et. al. suggested that the two latitude scales depicted on the 1403 Becharius chart might be original (though further study is needed), which would make the chart highly revolutionary for its time.[107] Whatever the case, latitude scales began to appear regularly on all charts and atlas maps which included the Atlantic from the second quarter of the sixteenth century. They were, as Astengo noted, never used if the chart did not extend beyond Gibraltar, because latitude was unnecessary for Mediterranean navigation.[108]

[106] Astengo: (2007), p. 193.

[107] Lepore, Fortunato et al.: 'The autumn of mediaeval portolan charts. Cartometric issues', *e-Perimetron*, 7: 1 (2012), 16-27. pp. 21-22. Their findings are discussed in greater detail in the Becharius case study in Chapter II.

[108] Astengo: (2007), pp. 193-194.

According to Cortés, the latitude scale was drawn north-south and placed somewhere near the Azores. The degree markings were either copied from the exemplar in the same manner as the distance scale or, if the exemplar was 'ungraduated', Cortés' instructions recommended measuring out seven primary divisions from the distance scale (equal to 87.5 leagues) and divide this into five equal parts of 17.5 leagues, each of which was equal to one degree, and begin numbering across from Cape St Vincent at 37° north. Cortés explained however, that although the Spanish used a 17.5-league degree, others measured a degree at 16⅔ leagues, that this had caused problems in the use of charts.[109]

Decorative Elements: Island and Coastline Colour

One of the final steps in creating a chart was the colouring of islands and the coastline. The colour of the mainland coastlines was variable: some chart-makers did not not colour the coast, some used a single colour, some used a second for major islands like Sardinia, and some later (sixteenth and seventeenth century) chart-makers altered the colour along the coast depending on sovereignty or region, not unlike modern political maps. Although colour was not entirely necessary, nearly every surviving chart has coloured islands. The reason was that the hydrography of small islands is considerably easier to visualise if they are not only coloured, but in a range of hues. Compare figures 1.47 and 1.48 of the Adriatic of the third reconstruction before and after the painting was completed: the islands are considerably easier to pick out when coloured, and different colours additionally made finding and keeping one's place easier when looking at the map.

Generally, between five and eight colours were used: red, green, blue, and brown were the most common, followed by yellow or gold (heraldically the same), various shades of pinks/purples, white/silver[110] (also heraldically the same), and finally orange. Both pigment-based and dye-based paints were used, the former appearing much thicker and more dense in colour than the latter, which often appeared like watercolours. As to the exact chemical compositions of these paints, a skilled codicologist or art-historian might often be able to make an educated guess; for instance, if the green paint/ink had 'burned' through the parchment, it was probably verdigris or the more expensive malachite, whereas

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[109] Cortés: (1551), pp. 130-133 (ff. 64r-65v).

[110] Tony Campbell noted that silver was a notoriously difficult colour to determine because it had often tarnished to black. Campbell: (2011).

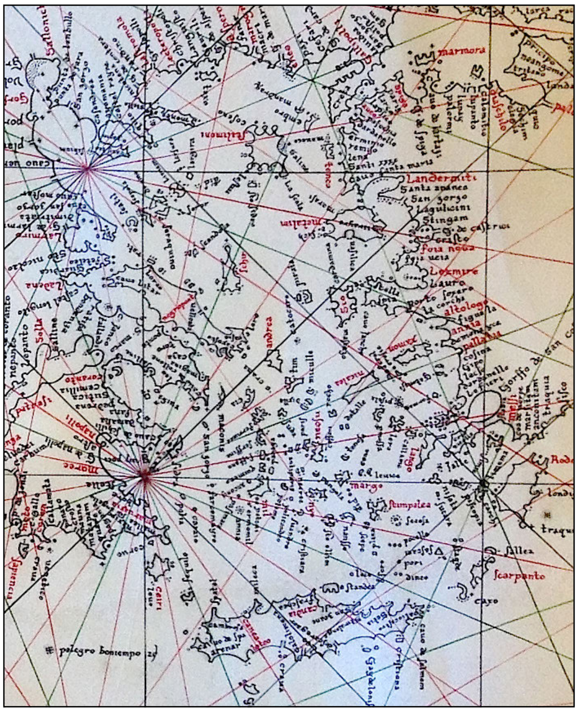

Figure 1.47: The Adriatic Sea, from the third reconstruction before colouring was applied.

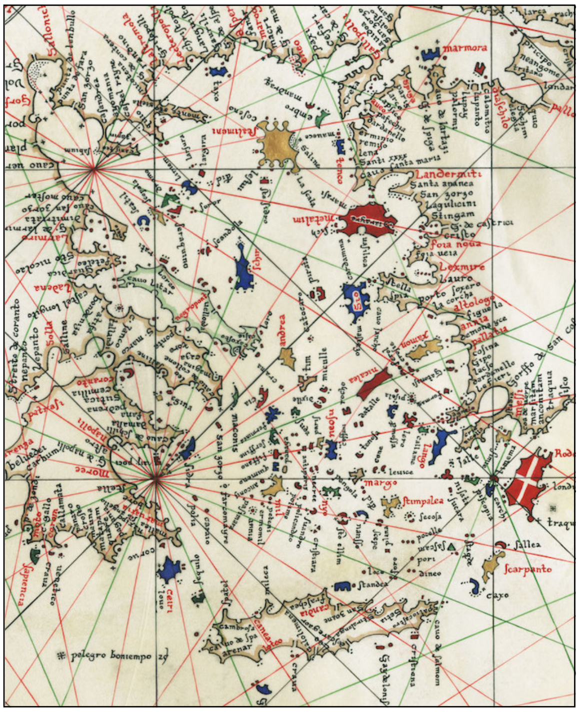

Figure 1.48: The Adriatic Sea, from the third reconstruction after colouring was applied.

if it had not, it was probably the more natural earth pigment *terre verte*.[111] However, only archaeometric analysis using one of various techniques such as x-ray diffraction can assuredly identify the chemical composition of paints.[112] A study of the pigments used on the famous Martin Behaim globe revealed that the red was cinnabar, the green was verdigris, the blue was azurite and the yellow was ochre, all the more inexpensive options for pigments.[113]

Campbell, in his 'Colour and Shape Analysis' online, examined the colouring of islands from most surviving charts and atlases dating between c.1290 and 1469, and compared the islands both within the chart-makers' individual corpora, and between makers, to determine if there were consistencies and patterns. The analysis revealed that, with some exceptions, there were consistencies of colouring between makers working out of the same location, especially amongst the Catalan maps. For example, on charts made at Palma de Majorca, from the Catalan atlas onwards, Majorca was always coloured with red and gold stripes, Minorca was red, Ibiza was blue, Paxos was red, and Limnos was blue.[114]

[111] For an excellent overview of the history of medieval paint manufacture and use, see: Thompson, Daniel V.: *The Materials and Techniques of Medieval Painting* (Allen & Unwin, 1936; repr. New York: Dover, 1956).

[112] The archaeometry of manuscripts was the subject of my master's dissertation.

[113] Astengo: (2007), p. 188.

[114] Campbell: (2011).

While there were some conventions between Venetian makers, Campbell found that there were few clear patterns between Genoese practitioners. Within individual chart-makers' corpora of work, Campbell found that: "none of those chartmakers who have left us sufficient material for meaningful comparison treated colour as a matter of random choice."[115] However, whereas Benincasa and Roselli were very consistent in their colour patterns, no atelier produced works with complete consistency; there were always some variations.

Campbell questioned why there would be any variation in the colouring of islands if chart-makers were copying from an exemplar. He posited that if Pujades' assertion – that charts were produced quickly and *en-masse* – was correct, then why would colour not be copied according to an in-house style, since it would have required less forethought and time? The goal of colouring seemed to be to make adjacent islands as different as possible; if they were coloured at random, one might be left in a situation where it was impossible to meet this criterion. Unfortunately, Campbell's analysis did not take into account every island of the Mediterranean, only major ones, and he did not indicate any situations where two adjacent islands were painted identical colours.

Of the roughly forty charts examined for this thesis, it would appear that chart-makers were careful to not colour two adjacent islands the same, unless they were quite small, in which case red was always used. From the experiential knowledge gleaned from the reconstruction experiment, the following process seemed standard: red would have been used first to colour nearly all small islands (less than 2mm width), and this may have even happened at the same stage as the red toponyms were written. This would have resulted in between a quarter and half of all islands being red: far more than any other colour. Next, proceeding one colour at a time, the exemplar would have been copied for the largest islands, e.g. Majorca, Malta, the Negropont, Limnos, and Lesbos, but only loosely followed for the smaller islands because it would have taken more time to copy every colour exactly. This would have resulted in charts that were more consistent in colour choice than pure chance would allow, but not perfect imitations, which would have taken more time.

[115] Ibid.

The Reconstruction: Island and Coastline Colour

Though the smallest red dots indicating sandy shoals were completed when the red toponyms were written, all the other hydrographic colouring was completed at this stage, a single colour at a time. The colours used for the second two reconstructions were pre-mixed ink, of the same kind used in the previous stages of construction; the blue, green, and brown were mixed with water to be lighter in shade. Gold ink was used on the final reconstruction, and was a premixed Windsor & Newton™ ink made from powdered gold leaf suspended in a binder. All were applied using a small sable brush. Although the colours were not medieval or early modern, it is possible chart-makers bought pre-mixed paints, or had an apprentice mix the colours required.

In order to test the theory that colouring the islands entirely differently to the exemplar would have required more forethought and time than straightforward copying, no attempt was made to follow the island colours that appeared on the exemplar, with the exception of the smallest islands which were coloured red as would have been normal, and Rhodes, which was given the standard white cross on red of the Knights Hospitaller. The following table presents the time it took to colour the islands on the three reconstructions.

No.	*Materials*	*Coverage*	*Islands**	*Time*	*Time per Island*
1	Modern card; Prismacolor™ markers	Adriatic	39	15m:40s	24.1s/island
2	Parchment; inks & brush	Adriatic	39	28m:17s	43.5s/island
3	Parchment; inks & brush	Mediterranean	261	2h:40m:05s	36.8s/island
* This number is the sum of all labelled islands, and other large islands that were coloured but not ascribed their own toponym. The number does not include small islands that were merely red dots.					

Red was applied first, followed by blue, green, brown and finally gold. Throughout the process, it was found that as long as the colours were spaced out, it required no significant planning; in fact, it seemed as though it would have been slower to copy the colours precisely from the exemplar. This confirms the above hypothesis that major islands were generally copied (as the evidence clearly shows), but minor islands were coloured without concern for following the original. A more thorough analysis of all islands, following Campbell's study, might further confirm this.

While the gold applied was a gold ink, in the late medieval and early modern period, gold leaf would have been more common. De Hamel provided an excellent description of the process for applying gold and silver leaf.[116] Gilding was a laborious and expensive process, and fewer than half of surviving portolan charts used gold or silver. The process would have taken considerably longer per island than the average 36.8 seconds as shown above.

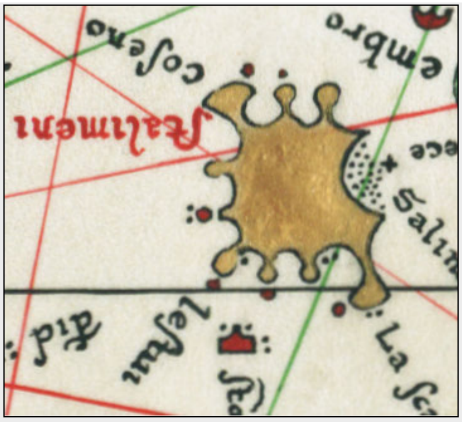

Figure 1.49: The Adriatic island of Limnos, painted gold, from the third reconstructed map.

Although the 1403 Becharius chart did not depict coloured coastlines, it was thought prudent to test this as well, because numerous portolan maps depict coastlines shaded in various hues. Thinned sepia ink – and on the third reconstruction for Corsica, Sicily and the Negropont, thinned green ink – were used, all applied with a small sable brush. The following table shows the time it took to colour the coastlines.

Figure 1.50: A painted chiaroscuro effect, applied to the coastlines on the 1489 Albinus da Canepa chart. Image courtesy of: Minneapolis: JFBL, B1489mCa.

No.	*Materials*	*Coverage*	*Coastal T-nyms*	*Time*	*Time/ T-nym*
1	Modern card; Prismacolor™ markers	Adriatic	135	2m:57s	5.8s/tn
2	Parchment; inks & brush	Adriatic	138	23m:17s	10.1s/tn
3	Parchment; inks & brush	Mediterranean	937	2h:11m: 23s	8.4s/tn

The above chart demonstrates that coastal colouring was not a slow process, only taking approximately two-three hours for a single pass with a brush on a full-sized chart. However, numerous portolan maps exhibit a chiaroscuro effect applied to the

[116] De Hamel: (1992), pp. 57-61.

coastal colour, indicating there have been three or four passes made with a brush. An example is shown in figure 1.50, where Albinus de Canepa on his 1489 chart took the time to shade all of the mainland coastlines in this fashion. This would have taken considerably longer.

Decorative Elements: Compass Roses

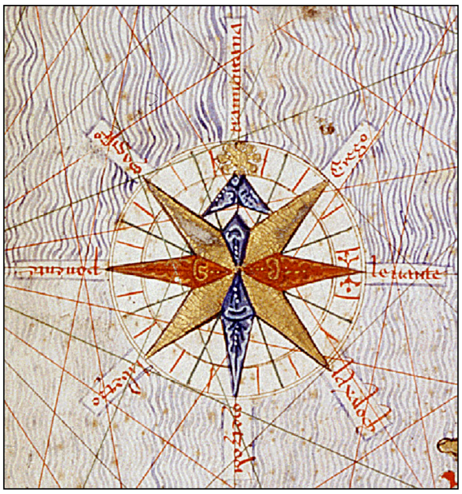

Figure 1.51: The compass rose from the c.1375 'Catalan Atlas' (Paris: BN, MS. Esp. 30). Image from Pujades i Bataller (2007) DVD Supplement.

Though the colouring of islands and coastlines served a practical purpose, the addition of compass roses (also known as wind roses) was more decorative. The first portolan map to include a true compass rose was the c.1375 Catalan Atlas, the author of which – Abraham Cresques – was also an accomplished compass maker.[117] Prototypes of the compass or wind rose appeared early in the genre, often using symbology, like depicting the north star at the top of the central north-south rhumb.[118] This motif can be seen on the 1330 and 1339 Dulceti charts. Despite their introduction in 1375, compass roses were not often used until after the mid-fifteenth century, but later in the sixteenth and seventeenth centuries, they became numerous and elaborate, often placed on every rhumb line convergence where it would not interfere with the coastline, as shown in figure 1.54. Astengo posited that by the end of the genre, the roses had become gaudy and poorly drawn,[119] yet there are many examples of beautifully decorated roses as well.

Figure 1.52: The pole star, appearing on the 1330 Angelino Dulceti chart (Florence: private collection). Image: Pujades i Bataller (2007) DVD Supplement.

Figure 1.53: The pole star, depicted on the 1339 Angelino Dulceti chart (Paris: BN, Rés. Ge. B 696). Image: Pujades i Bataller (2007) DVD Supplement.

[117] Campbell: (1987), p. 429.

[118] Pujades i Bataller: (2007), p. 483.

[119] Astengo: (2007), p. 192.

Although it has been claimed that the compass rose was integral to the utility of the portolan chart, the fact that not every map included them indicates they were unnecessary and thus mostly ornamental.

There were no codified rules for the composition of a compass rose, and every chart-maker seemed to have his own artistic style: the roses ranged from simple triangles in a circle, to highly complex gilded works of art. There were consistencies however: a cross was often drawn to indicate east, which most scholars have assumed is a reference to Jerusalem or perhaps the Garden of Eden, which appeared in the far east on *mappaemundi*. Italian roses tended to indicate north with a triangle or chevron, whereas Catalan charts often indicated north with a fleur-de-lis. Sometimes a star was drawn towards north as well, referencing the pole star. Many of these motifs were common to other maps as well. Winter proposed that compass roses are useful for identifying anonymous charts by comparing them with the roses of authored maps,[120] but this has encountered criticism. Roselló Verger disagreed with the assumption that chart-makers adhered to the same style throughout their corpora of maps,[121] and Campbell revealed that Winter's research was flawed because he used undated charts within his catalogue.[122] Astengo posited that it could be a successful venture, but a fully complete catalogue of compass roses from every known chart-maker would be necessary.[123]

Figure 1.54: A bifolio map from the 1619 Salvator Oliva atlas (San Marino: Huntington, HM2515), depicting eleven compass roses. Image: Wikimedia Commons.

[120] Winter: (1950), pp. 37-40.

[121] Astengo: (2007), p. 192.

[122] Campbell: (1987), p. 395.

[123] Astengo: (2007), p. 192.

The Reconstruction: Compass Roses

Although the 1403 Becharius chart did not feature compass roses, it was thought prudent to draw them for the experiment. Five in all were drawn between the three maps. It is unknown whether chart-makers had access to any circular stencil-like implements around which to draw perfect circles; it was more likely that dividers were used to draw a circle in drypoint, which would then be drawn over in ink by hand. All the triangles and other shapes would be drawn in black ink, and finally areas painted and gilded.

Two dichromatic compass roses were drawn on the first reconstruction, using modern black and red pens, which took a total of 33m:37s. A single compass rose of three colours was drawn on the second using a dip pen in ink, then painted using a small brush, taking 36m:50s to complete. The third featured two compass roses: one with four colours and one with five colours (both including gold), drawn using a dip pen and ink. Together these took 2h:39m:58s to draw. While it is difficult to glean definitive conclusions from these times, it can be said that compass roses could take a long time to paint, especially if they were ornate.

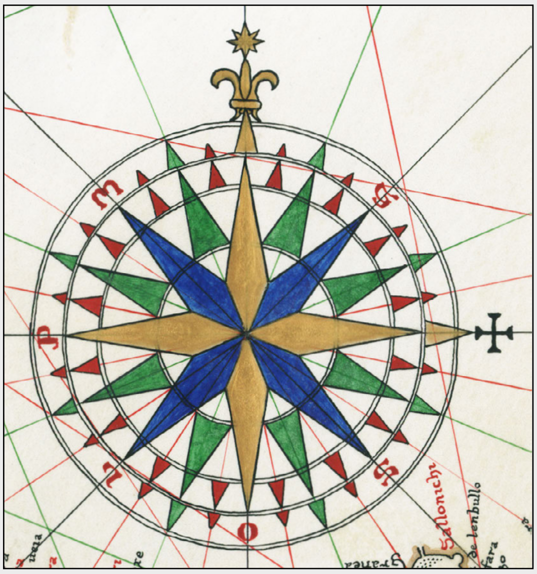

Figure 1.55: One of the two compass roses drawn on the third reconstruction.

Decorative Elements: City Miniatures, Flags, and Other Features

A plethora of decorative elements could be added to these charts, including the following: city miniatures, flags, religious symbols and portraiture, ships, monarchs, trade caravans, animals (both fictitious and real), geographical features such as mountains and oases, and purely decorative ornamentations from geometric to natural. Although it is unlikely any utilitarian chart would have been unnecessarily adorned, these extraneous ornamentations appear to have been popular, especially amongst Catalan and Genoese charts, and later maps from the sixteenth century onwards. While some features were purely aesthetic, others complemented the nautical with other geographic, anthropological, and political information. Ways in which these decorative elements were used to provide meaning to portolan maps are evaluated on a specific basis in the case studies of Chapter II, and more generally in Chapter IV.

The Reconstruction: Decorative Elements

The 1403 Becharius chart used as the exemplar was not particularly adorned. It displayed only three flags, and ten city miniatures. It was thought prudent however, to draw a few city miniatures and flags in the reconstruction.

A miniature of Venice was drawn on the first reconstruction using modern pens and markers, which took 10m:12s. A flag was included (argent, a lion passant gules)[124] which did not appear on the exemplar. A similar city miniature and flag was drawn on the second reconstruction, using a dip pen, inks and a small brush, which took 21m:04s. On the third reconstruction, city miniatures of Avignon, Genoa, and Venice were drawn, with appropriate flags.[125] These took a total of 1h:46m:35s.

Figure 1.56: The city miniature of Genoa, drawn on the third reconstruction.

The drawing of these adornments on the reconstructions indicated the length of time decorations must have taken: if three city miniatures took nearly two hours to paint,[126] a heavily-adorned map such as the 1563 Diegus Homem chart might have taken longer to decorate than to have drawn the rhumb network, copied the coastline, and written the toponyms altogether. Undoubtedly the price of a chart correlated to the extent of its

124 An unfortunate mistake was made on the three reconstructions to use only a lion instead of the correct winged lion of Saint Mark, which was and is the heraldic symbol of Venice. The mistake was a result of not checking and instead working from memory. However, though mistakes like this were probably common, it would only take a moment to rectify this one by adding wings. Similarly, many initial mistakes are completely unknown to scholars if they were corrected.

125 Avignon was gules, three keys argent; Genoa was argent, a cross gules; and Venice was argent, a lion statant gules. Once again, a mistake was made not to draw the lion with wings.

126 Once again, my personal experience in artistic map illustration should be taken into account. As demonstrated in figure 1.1, my skills are comparable to that of at least a chart-maker's apprentice, and thus the times taken can be considered indicative.

decoration, which is verified by associated contemporary documents as discussed in Chapter III.

Figure 1.57: The elaborately decorated 1563 Diegus Homem chart. Florence: BNC. Image from Wikimedia Commons: <http://commons.wikimedia.org/wiki/File:Diogo_Homem_1563.jpg> [Accessed 13 February 2014].

The extent to which chart-makers would work on commission or keep a regular stock of maps to sell, and whether or not makers would have employed separate artists to decorate their maps is debatable. It might have been logical to leave some decoration to be completed upon purchase, and there are instances to support this claim. Several Agnese atlases display an empty framed section of scrollwork on which a coat of arms could have been drawn later.[127] Additionally, as discussed in the case study in Chapter II, the 1468 Benincasa atlas featured a prominent city miniature of Genoa with five silver-gilded flags.[128] It was highly unusual for Benincasa to include decorations, let alone of his homeland's primary maritime rival, thus it was likely commissioned by the purchaser of the atlas, Prospero Camulius de Medici. The market for decorative maps, and the patterns concerning the chart-makers is discussed in Chapter III.

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[127] Ibid. p. 178.

[128] Benincasa, Gratiosus (1468): London: BL, Add. MS. 6390, f. 4v.

Expository Texts and Signatures

The final addition made to portolan charts was text, most commonly signatures, but also tracts that ranged from brief sentences to lengthy expositions. Neither Cortés nor Crescentio discussed the addition of text, or signatures, but presumably this was done at the end of the process. Examination of a number of portolan charts and atlases revealed no designated 'text boxes', i.e. spaces that were outlined and left free from the rhumb network in the initial planning stages; in contrast, areas meant for the scale bars were often demarcated. Texts were written directly above the rhumb network, in areas that did not disrupt the hydrography of the map.

There have been different estimates as to how many charts were signed, and how many were left anonymous. Caraci estimated that 36-38% of charts were anonymous, whereas Baldacci estimated the figure might be as high as 60%.[129] A survey by Astengo calculated the figure to be around 40%, but posited that even this figure meant that there was a desire not to sign a chart in some circumstances.[130] Possibly, charts and atlases were left unsigned when made by an apprentice, and sold at a lower price than those made by the master cartographer. Yet, as Astengo pointed out, some prolific chart-makers never signed their work, an example being the sixteenth-century Venetian atlas-maker Francesco Ghisolfi, to whom eleven masterful atlases are confidently attributed.[131]

Signatures were written in either red or black, and were formulaic, including the following parts put together in different orders. First, the name of the author and sometimes his place of birth, e.g. "Perrinus vessconte d'Janua" or "Gratiosus de benincasa Anchonitanus" were written. Second, the phrase 'made this work' appeared, often in Latin, but sometimes in the vernacular, which became more common over time. The chart or atlas to which the signature referred was usually written either as 'carta' or 'opus' but sometimes 'tabula' was used. 'Made' usually took the form of 'fecit' or 'composuit'. It has been suggested that the two words had different meanings: Astengo discussed the signature of the 1563 Jacobus Russus chart which referenced two different makers, positing that 'fecit' referred to the intellectual task of cartography, whereas 'conposta' (*composuit*) referred

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[129] Astengo: (2007), p. 190 notes 90-91.

[130] Ibid. note 92.

[131] Ibid. p. 215

to the manual task of copying,[132] though this could be interpreted conversely.[133] Third, the signature might include the location at which the chart was composed. For example, the 1403 Becharius chart noted both that Becharius was a "ciuis Janue" and that the chart was made "in ciuitate saone". Finally, the signature nearly always included a date. Often this was only the year, but sometimes included the month or even the day: presumably in the latter case it was the day on which the map was completed because it would not have been possible to entirely compose even the simplest chart in a single day. The signature from the 1646 atlas by Friar Nicolò Guidalotti included "a Kal Xbris ad Kal Maias 1646", indicating it took him five months to complete.[134]

There is evidence that portolan maps were signed only upon completion, and sometimes not even until a buyer had been sourced. The signature of the 1497 chart by Jehuda Abenzara is dated 8 February 1497, and referred to a deposit left by the Sultan of Cairo to purchase the map only a few days previously.[135] The map must have been largely finished, but the signature was added only once the buyer had been found. Furthermore, the signature of the 1468 Benincasa atlas referred to its purchaser, Prospero Camulius de Medici; thus, it was likely an 'off-the-shelf' atlas.[136] Because some signatures were added when sold, not when completed, the dates on maps cannot necessarily be used to infer the pace of production.

Explanatory texts were more rare than signatures: only a small number of charts contained them, nearly all of which date before the sixteenth century. Usually, these texts were placed in the peripheral regions of the map such as Scandinavia, Africa, or the Orient, places beyond the reach of sailing vessels which aroused the curiosity of learned men. Most of the tracts concerned geographical, political, historic, biblical, or anthropological information, and were derivations of similar texts found on *mappaemundi*. A brief but commonly-found example was next to an isthmus across the northwest lobe of the Red Sea: on the Hereford *mappaemundi*, the text reads: "transitus filiorum israel per

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[132] "Iacobus russus messanensis me fecit in nobili ciuitate messane anno domini 1563 per Joanes antonio talamo conposta amen". Russus, Jacobus (1563): Valencia: University of Valencia Library, MS. 896. See: Astengo: (2007), pp. 189-190.

[133] Whereas 'conposta' was interpreted as an incorrect spelling of the verb 'composita' meaning 'to construct', it could equally be a misspelling of the accusative of 'compositum', meaning an agreement or pre-arrangement; thus, Antonio Talamo might have commissioned the map.

[134] Ibid. p. 189.

[135] Campbell: (1987), p. 436.

[136] This is discussed in greater detail in the Gratiosus Benincasa case study in Chapter II.

Figure 1.58: Transit of the Israelites across the Red Sea, depicted on the Hereford mappamundi. Image from: Harvey (2010) p. 15.

Figure 1.59: Transit of the Israelites across the Red Sea, depicted on the 1339 Angelino Dulceti chart (Paris: BN, Rés. Ge. B 696). Image: Pujades i Bataller (2007) DVD Supplement).

mare rubrum" (figure 1.58); on the 1339 Dulceti chart the same isthmus appears with the text: "transitus filiorum Isdrael leui" (figure 1.59); on the late-fourteenth-century anonymous chart (attributed to Cresques' atelier) it reads in medieval Catalan: "per aquest loch pessaren los fills disrael com isqueren de gipte";[137] and on the 1413 Mecia de Viladestes chart it reads similarly: "per aquest loch passaren lo fils d'srael com isqueren de gibta per mà de moyces profeta de deu".[138] By the sixteenth century, once these regions had become increasingly explored, their intellectual novelty must have waned to the point that expository texts about the regions were no longer popular, though similar texts began to be found upon printed planispheres at the foremost limits of the explored world.

The Reconstruction: Texts and Signatures

On the three reconstructions, no tracts of text were added, but a signature was written on each, following the structure outlined above. They took 6m:33s for the first reconstruction, 8m:32s for the second, and 15m:03s for the third.

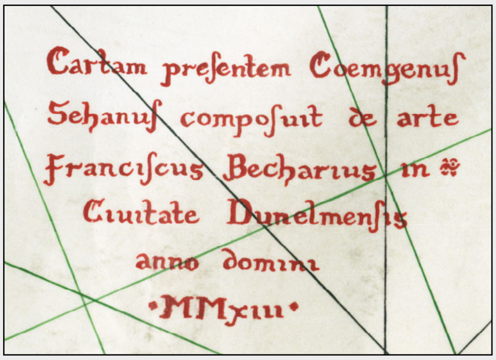

Figure 1.60: The signature written on the third reconstruction.

[137] "By this place passed the sons of Israel as they went out from Egypt". Naples: Biblioteca Nazionale, ms. XII, D102.

[138] "By this place passed the sons of Israel as they went out from Egypt by the hand of Moses, prophet of God". Paris: BN, Rés. Ge. AA 566.

Analysis of the Reconstruction

This chapter comprised two primary aims: first, to provide a comprehensive overview of the various facets of the production processes used to create portolan charts, and second, to undertake and discuss the first published archaeological reconstruction of a portolan chart. The preceding discussion enables a more comprehensive picture of portolan map production to be envisioned, and subsequently, the market that existed for them, and their functions, can be better understood.

The Nature of Copying

Evidence suggests that nearly all portolan charts were copies made from exemplars, and that most workshop exemplars were themselves copies, either passed down through generations of family-run workshops, purchased, or stolen. The signature of Petrus Roselli on his 1447 chart contained the phrase "de arte Baptista Beccarii", which has been interpreted as an "expression of esteem", or recognition of a master by a pupil.[139] However, it is equally likely that Roselli, new to the chart-making trade,[140] was indicating that he had copied his map from another map by Batista Becharius, son of Franciscus, who was most likely using his father's updated charts himself.

The works of Bartolomeo Crescentio and Martín Cortés indicate that copying was the primary method utilised to create portolan maps. It is absurd to think that every chart would have been based on directly surveyed hydrographic and toponymic information. Instead, evidence suggests that regular updates to established models were incredibly rare. For example, when Franciscus Becharius changed the position of Sardinia, he wrote an exposition defending that he did this following the testimony of those proficient in navigation who professed its incorrectness.[141] It was not unusual that the chart-makers were conservative and wary of change; this was fairly normal amongst artisans and scribes of

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[139] Campbell: (1987), p. 431.

[140] His first two surviving charts date from 1447.

[141] This is generally referred to as his 'Address to the Reader', and is discussed in detail in the Becharius case study in Chapter II.

the late medieval and early modern period.[142] However, chart-makers generally welcomed new additions when possible: the extension of the African Atlantic coastline was reflected on the portolan charts of Andrea Bianco and Gratiosus Benincasa within a decade of Portuguese discoveries.[143] Likewise, the central Atlantic archipelagoes appeared quickly on charts as well; some scholars maintained that certain islands appeared earlier on maps than in records: Armando Cortesão believed that Madeira appears on the 1339 Dulceti chart, 80 years before its documented discovery.[144]

Although Campbell and other former scholars postulated that the exaggerated hydrography of the charts was an aid to navigation, evidence gleaned from the reconstruction experiment indicated that it was more likely to be a result of the copying process, as Pelham suggested. Whether that involved dots of pounce being connected in sweeping arcs, using the *trasflorar* process, or copying via the square-grid system, it seems most likely that the increasing hyperbole and geometric simplification was a result of copies made from copies, resulting in a slow metamorphosis of the coastline, hardly noticeable between an exemplar and its direct copy, but quite noticeable several iterations later. Indeed, the earliest maps did not show the coastal simplification and hyperbole, as will be shown through coastline comparisons in Chapter II.

Other aspects of their construction, i.e. scale and toponymy, also reveal that portolan maps were copies. That chart-makers adhered to one or two particular scales in their corpora, rather than scaling maps to any ratio, confirms that direct 1:1 copies from exemplars were the norm. The table of charts and atlases by Pujades shows for example, that Benincasa drew all his atlases either at 1.0 or 1.3 cm to 50 *miglia*, all of Roselli's charts between 1462 and 1468 were 1.0cm : 50 *miglia*, and all three of Batista Beccari's charts were drawn at 1.2 cm to 50 *miglia*, among numerous other examples. Additionally, comparison between the unusually large-scale regional chart of the Ligurian Sea made by Jacopo Maggiolo in 1567 (4.5 cm : 50 *miglia*) and his 1563 standard chart (1.0 cm : 50 *miglia*) revealed that the former was no more hydrographically precise (unexpected given its

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142 For example, while Mercator's new mathematical projection, designed for navigation, was published cartographically in 1569, its uptake was slow and it did not begin to be used by sailors until the seventeenth century, and was never adopted by portolan chart-makers. See: Monmonier, Mark: *Rhumb Lines and Map Wars: A Social History of the Mercator Projection* (Chicago: University of Chicago Press, 2004). p. 11, and Taylor, E. G. R.: *The Haven-Finding Art: A History of Navigation from Odysseus to Captain Cook* (London: Hollis & Carter, 1956). p. 222.

143 Campbell: (1987), pp. 413-414. This is discussed in more detail in Chapter IV.

144 Ibid. p. 410.

scale), and both appeared to have been copied from the same exemplar; the larger scaled one probably via the use of the square-grid method.[145]

Accuracy

Although accuracy will be analysed in greater detail in the final chapter, it is worth discussing how the production process, as gleaned from the reconstruction experiment, affected accuracy. It would seem illogical that a chart-maker would have had two hydrographically-different patterns from which to copy, i.e. one less accurate for luxury maps, and one more accurate for utilitarian navigational maps. Certainly they may have had different exemplars at different scales, but they would have used the same spatial information. It has been claimed that the large-scale 1567 chart by Jacopo Maggiolo mentioned above was a utilitarian chart for navigation,[146] yet it was no more hydrographically accurate than a standard portolan chart, and appeared to be based on the same exemplar as a 1561 chart by the same author. Logically, all portolan maps were copied from the best exemplar available to their maker at the time.

The rapid incorporation of the most recent discoveries, even if unconfirmed and inaccurate, demonstrated that portolan map-makers desired to provide 'the latest charts' to their patrons. However, there did not seem to be a conscious effort to refine the already known hydrography, and in fact, there was a general decline in the accuracy of the Mediterranean coastlines from the mid-fifteenth century onward. This can be attributed to the copying process, whereby centuries of cumulative inaccuracies crept in, which although mostly indistinguishable between the the copy and its direct model, caused significant degradation over tens or even hundreds of generations of portolan charts. Whether or not the inaccuracies were problematic depended entirely on the function of the map: it would have been less a problem for aesthetic maps than navigational aids.

Time

One of the primary intentions of undertaking the reconstruction experiment was to develop tangible evidence to supplement documentation concerning how long it would

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[145] This is discussed in detail in the Jacopo Maggiolo case study in Chapter II.

[146] Astengo, Corradino: 'Una Carta de Navigare del 1567', *Itineraria: Letteratura di viaggio e conoscenza del mondo dall'Antichità al Rinascimento*, 2 (2003), 289-303.

take to produce a portolan chart. The following table displays the total times it took to complete the three reconstructions.

No.	*Rhumb Network*	*Hydro-graphy*	*Topo-nymy*	*Scales*	*Colour*	*Other*	*Total Time*
1	35m:49s	1h:07m:18s	1h:16m:56s	17m:21s	18m:37s	50m:22s	4h:26m:23s
2	1h:47m:08s	53m:05s	1h:25m:36s	33m:17s	51m:34s	1h:06m:26s	6h:37m:06s
3	3h:46m:26s	11h:59m:58s	12h:19m:00s	1h:15m:09s	4h:51m:28s	5h:21m:36s	39h:33m:37s

It must once again be stressed that this reconstruction was not undertaken without considerable former practice at drawing, drafting, map-making, and calligraphy. Furthermore, the process of production was well-studied before undertaking the reconstruction. As a result, the times calculated for the second and third reconstruction are acceptable approximate values for an apprentice or assistant chart-maker. Although speculative, it is doubtful that a master portolan cartographer could make the same map in anywhere less than 80% of the times listed above, without suffering a loss of quality. However, certain measures could have been used to save time: as discussed in the hydrography section of this chapter, a copied coastline on the transparent tracing paper could have been used several times to make identical maps, saving several hours of work. Additionally, if Crescentio's backlit tracing method was employed to copy directly from one exemplar to the new map, there would have been no need to make intermediate paper tracings. Finally, if one chose to omit all decoration except for colouring the islands (which had a functional purpose), several hours would be saved.

Nevertheless, the reconstruction indicates that making a single portolan chart was a considerable investment in time. The third reconstruction took nearly forty man-hours to produce, not including any breaks: the times were taken with a stopwatch, only running when each map was physically being worked upon. However, a cartographer would not have been able to work for several contiguous hours without respite, and other activities would have additionally required his attention, which were not calculated in the times above, including sharpening or re-cutting quill pens, mixing inks, dealing with customers, acquiring and preparing materials, etc.

It must also be taken into account that the third reconstruction was not a full-sized chart; it omitted the easternmost quarter of the Mediterranean, the Black Sea, and all of the Atlantic coastlines, from northern Europe and the British Isles to Africa. Because it was thus only half-sized, one might logically expect a full portolan chart to take double the time. As a result, it would be safe to estimate that working at a diligent pace full-time (ten hours per day with two hours total of breaks or other workshop activity, six days a week) it would have taken a single skilled chart-maker a minimum of one-and-a-half to two weeks to make a full-sized portolan chart without decoration. Significantly ornamental charts might have taken several months to produce.

Both documents and surviving maps themselves additionally reveal some clues as the the time is could take to create a portolan chart. Mentioned earlier was the signature of Friar Nicolò Guidalotti contained within a four page atlas dated 1646, which took him five months to complete: "a Kal Xbris ad kal Maias." However, Astengo posited that this was the work of an amateur, thus necessitating much more time than a well-organised workshop.[147]

Pujades i Bataller brought to the attention of scholars an invaluable contract dated 12 November 1433, between Gabriel de Valseca and Majorcan merchant Jacobo Torella. Within the contract, Valseca agreed to pay off his brother's debt of seventy pounds (*libras*) by supplying Torella with twenty-eight "cartes de navagar bones et sufficientes": four immediately, and twenty-four within six months.[148] What this document shows is that it was possible for Valseca to create twenty-four charts in six months, which equates to one chart every 7.6 days. Presumably the maps were simple and undecorated, but there were no details concerning their hydrography, which might have ranged from individual basins such as the Adriatic, to the entire Mediterranean, Black Sea, and Atlantic coastlines. If they were of the Mediterranean only, twenty-four charts in six months would fit with the timings indicated by the reconstruction experiment, though they were probably produced at a grueling pace. Whether Valseca had any help, such as an apprentice or atelier, is unknown. Pujades concluded from the pace that Valseca must have needed the productive capacity of an atelier to complete the work,[149] but the reconstruction timings indicate that he could

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[147] Astengo: (2007), p. 189.

[148] Mallorca: Arxiu del Regne, Protocols, S-28, ff. 69v-70r. See: Pujades i Bataller: (2007), pp. 497-498, and Pujades i Bataller, Ramón J.: *La Carta de Gabriel de Valseca de 1439*, trans. by Catalina Gironda Arguimbau (Barcelona: Lumen Artis Ediciones, 2009). pp. 327-329.

[149] Ibid.

have produced them by himself, albeit arduously. There is no evidence that he ran a significantly-sized workshop.

Ateliers vs. Individuals

The estimates of required time are based on the productive output of a single chart-maker, so it could be assumed that a large workshop would have the ability to produce considerably more charts through economy of scale. However, Campbell warned against the common assumption made by numerous scholars that charts were produced in workshops, and lamented that there is very little direct evidence concerning cartographic ateliers.[150] However, the extant evidence indicates production of maps by individuals, and single master-apprentice duos, rather than workshops employing several apprentices, amanuenses, and artists.

Documentary evidence suggests a lack of established cartographers, particularly in fifteenth-century Genoa: in 1438, Agostino Noli petitioned the Council of Elders for a cancellation of his taxes because he was the only active chart-maker in the city, which was granted for ten years with the proviso that he train his brother in the art of map-making.[151] This certainly would not have been the case had there been a portolan chart workshop in the city, and there is no evidence that Noli trained his brother. Another document from 1453 indicated that Bartolomeo de Pareto was now the only present chart-maker in Genoa,[152] and he was granted the same tax exemption.[153] The doge and council of Genoa in 1518/19 encouraged Vesconte Maggiolo to return to the city to resume chart-making by offering him one hundred lire annually and appointing him official cartographer with a state-enforced monopoly.[154]

There is additional evidence of chart-making being a part-time activity, which seemed to be especially prevalent amongst Venetian map-makers, who were probably only making maps in the intervals between the annual galley voyages: the signature of the 1448 chart of Venetian Andrea Bianco revealed his position as '*comito de galia*' (boatswain);

[150] Campbell: (1987), pp. 429-430.

[151] Ibid. pp. 430, 434.

[152] Ibid. p. 430.

[153] Pujades i Bataller: (2007), p. 494.

[154] Astengo: (2007), pp. 209-210.

documents additionally link him with annual galley trade convoys between 1437 and 1451,[155] and Pujades concluded he was not engaged in full-time cartography.[156] The chart itself was produced in London, probably between voyages, all of which is certainly not indicative of workshop production. Likewise, Antonio Pelechan, from whom only a single map survives, was the *armiraio* of Rethymnon according to his signature,[157] thus responsible for administrative tasks, not running a cartographic workshop. Piero Falchetta deduced that much of the cartography in late medieval Venice was a subsidiary occupation undertaken by men who were primarily naval officers.[158] Pujades only partially agreed with this conclusion, citing that the works of Pongeto, Cesanis, Giroldi, and Nicolai were too expertly crafted to have been products of irregularity.[159] The same pattern however, was true for Andrea Benincasa, who was 'capitano del porto' of Ancona, and Campbell concluded his three maps were "the fruits of a less than full-time occupation."[160] Concerning Majorca, there is no direct evidence of ateliers existing; indeed, the 1408 letters between Datini agents in Barcelona and Majorca indicate that there was only one chart-maker – 'il Bizaro' – on Majorca, possibly Mecia de Viladestes.[161]

Finally, the itinerant nature of some chart-makers would have made it very difficult to be involved with large structured workshops. The first surviving portolan chart of Majorcan cartographer Jaume Olives, dated 1550, was produced in Marseilles; later ones indicate he was present in Messina in 1552 and 1561, then Naples in 1563 and 1564, Marseilles in 1566, and finally in Barcelona in 1571 and 1572.[162] Jaume's grandson Joan followed a similar peripatetic pattern: working in Messina 1592 to 1599, Naples 1601-1603, Messina 1606-1608, Malta in 1611, Marseilles 1612-1614, Messina again later in 1614, and Marseilles again in 1615.[163] Similarly, the authorial signatures indicate prolific fifteenth-century chart-maker Gratiosus Benincasa was – as Campbell pointed out – in Genoa in 1461, Venice between 1463 and 1466, Rome in 1467, Venice again from 1468 to 1469, Ancona in 1470, Venice from 1471 to 1474 and finally Ancona from 1480 to

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155 Campbell: (1987), p. 432.

156 Pujades i Bataller: (2007), p. 496.

157 Campbell: (1987), p. 434.

158 Falchetta: (1995), p. 85.

159 Pujades i Bataller: (2007), p. 496.

160 Campbell: (1987), p. 434.

161 Pujades i Bataller: (2007), p. 436; Pujades i Bataller: (2009), p. 312.

162 Astengo: (2007), p. 226 & appendix 7.2.

163 Ibid. p. 228 & appendix 7.2.

1482.[164] These patterns of movement are only recognisable when a large number of the maker's charts survive and they regularly signed the place of production, so it is impossible to know how many cartographers regularly moved around, but certainly some of these highly prolific makers could not have been masters of established ateliers.

Astengo discussed the numerousness of anonymous charts (which he estimated to be around 40 percent), theorising that while some anonymous charts were only occasional products of part-time map-makers, the sheer quantity is indicative of workshop production. This followed the hypothesis that anonymous works were drawn by apprentices, and were sold at a lower price than those of the master, which would have been signed to verify their superiority.[165] However, there is no substantive evidence to suggest that that was the reason many maps were unsigned: as Astengo himself admitted, several of the ten luxurious atlases attributed to Francesco Ghisolfi were owned by the Medici family, yet went unsigned by the author, which does not support his theory.[166] Ghisolfi's presumed predecessor and master – Battista Agnese – was the most prolific of all portolan map-makers: Eighty-two charts and atlases have been confidently attributed to him, with other possible ones as well, many of which were owned by high-ranking clergy, nobility and royalty. However, only twenty-one of the productions were signed, not including one probably owned by Henry VIII,[167] or another given by Emperor Charles V to his son Philip.[168] Likewise, the extensive 79-folio Cornaro atlas in the British Library was owned by the Venetian patriciate family of the same name, yet it too was left anonymous.[169] Amongst surviving charts, no scholar has been able to demonstrate any correlation between superior/inferior works and whether or not they were signed, thus while Astengo's theory is possible, it is unsubstantiated, and worth searching for alternative explanations.

This is not to say that ateliers did not exist: Agnese's considerable output, all produced in Venice, indicates he probably had some assistance, at the very least by his supposed pupil Ghisolfi. Certainly, there is evidence of fathers training their sons, e.g. Cresques Abraham and Jafuda Cresques, Gratiosus and Andrea Benincasa, Jacopo and

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164 Campbell: (1987), p. 432.

165 Astengo: (2007), pp. 189-190.

166 Ibid. pp. 179, 190.

167 Vatican: BAV, Cod. Barb. Lat. 4357.

168 Ibid. p. 178. Providence: JCBL, [no reference number].

169 Anonymous: *Cornaro Atlas*, (c. 1489): London: British Library, Egerton MS.73.

Pietro Russo, and Francesco and Battista Beccari, and family collaboration and apprenticeship, e.g. the Pizigani brothers, and the Oliva, Prunes, and Vesconte family dynasties. Campbell pointed out a statute by the Venetian artists' guild which stated that from the fourteenth century, workshops were obliged to employ no more than a single apprentice and two assistants.[170] The evidence suggests that most portolan charts and atlases were produced either by individuals working alone, or in small workshops of few people: there is no evidence of large workshops existing, and certainly not being the norm.

The Pace of Production

Astengo noted four atlases by Batista Agnese were made in the year 1542, dated 15 May, June (at some point), 28 June, and 25 September,[171] and Wagner dated another four anonymous but attributed atlases to the same year.[172] Although one might attempt to infer a pace of production from these dates, it has been established above that the dating of a portolan map could have been the date it was sold, rather than the date completed. Thus, it is not certain that Agnese made these four (possibly eight) atlases in a single year. If he had, it should not be expected that these represented a small fraction of that year's output; more likely it was a large portion of it.

Pujades, in his 2007 study, suggested "a system of almost mass production", and he based this assertion upon two pieces of evidence: first, the degree of coincidence in the pattern of the scale of portolan charts,[173] and second, the aforementioned document between Gabriel de Valseca and his brother's creditor Jacobo Torella.[174] Concerning the scale, as discussed above, Pujades compiled a table of 110 charts and atlases, and determined the length of the 50-*miglia* distances on each, revealing that the scales of maps were in clusters, instead of evenly distributed. However, clusters rather than an even distribution only reveals that chart-makers preferred the easier method of tracing and copying from some other chart, rather than the more time-consuming method of using a system of squares to enlarge or reduce the size. While Pujades' data set is invaluable, all it

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[170] Campbell: (1987), p. 430.

[171] Astengo: (2007), p. 189.

[172] Wagner, Henry R.: 'The Manuscript Atlases of Battista Agnese', *Papers of the Bibliographical Society of America*, 25 (1931), 1-100. pp. 64-69.

[173] Pujades i Bataller: (2007), pp. 204-209, 478.

[174] Ibid. pp. 497-498, and Pujades i Bataller: (2009), pp. 327-329.

proves is that chart-makers chose the easiest, quickest, and therefore least expensive method of reproduction. It does not prove, nor even suggest, that there was mass-production of maps.

Concerning the contract, Pujades inferred that if Valseca could make twenty-four charts in six months, in the thirty-eight years he was active, it would have been possible to make nearly 2,000 charts.[175] Although Pujades recognised that it is unknown if this production pace was steady, he concluded again that "we can certainly speak of serialized, nearly mass production of navigational charts."[176] As discussed above however, it is entirely unknown whether or not Valseca was able to fulfill his obligations, it is unknown what the dimensions or hydrographic coverage of the maps were, and the contract does not indicate this was a standard pace of production.

It must also be questioned whether there would have existed the market for thousands of portolan charts. If there was a considerable demand, why did Agostino Noli require remission from taxes in Genoa, and equally, why was he the only chart-maker present? Why, additionally, was it that so few cities developed as map-making centres, at least until the sixteenth century? Moreover, if useful for navigation, why were similar maps of the Baltic never produced by the Hanse? If the market demand existed, entrepreneurial artisans would have begun their own cartographic businesses all over the populous cities of the Mediterranean, but the evidence suggests this did not happen. It seems unlikely that Valseca – or any chart-maker – ever produced anywhere near a thousand maps in their lifetime.

Conclusion

The aims of the reconstruction experiment were to test and explore the various methods of production, and determine the time necessary to produce a portolan chart. No publications exist concerning cartographic reproductions of this sort, which has left the discussion of the manufacture of portolan maps purely academic, and often speculative.

Beginning with the rhumb network, the reconstruction demonstrated that it did not matter whether or not the network was drawn before or after the hydrography was copied,

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175 Pujades i Bataller: (2007), pp. 497-498, and Pujades i Bataller: (2009), pp. 327-329.

176 Ibid. p. 328.

as long as at least a single rhumb line was drawn initially by which to align the copy. For aesthetic and functional reasons of clarity, it made sense if the entire rhumb network was copied before the toponyms were written, so the latter could be written around the lines to be more easily read, and although not all chart-makers did this, it appears that most did.

The copying of the hydrography from the exemplar to the new copy was the most unknown aspect of the production process. The reconstruction verified that the *trasflorar* process described by Martín Cortés was a viable procedure, though the method had the potential to introduce minute errors, i.e. exaggeration and geometric simplification of the hydrography. The experiment also demonstrated that Crescentio's backlit tracing method worked, possibly without as much potential for error. As for the square-grid and pouncing methods, further experimentation would reveal their individual strengths and weaknesses, but both would have introduced errors as well. Considering invested time, given that Crescentio's backlit tracing method allowed for direct copying, whereas '*trasflorar*' and pouncing were indirect, the former would have been quicker. Unfortunately, there is no documentation to indicate that this was a well-known and utilised method. However, the intermediate transfers used for the pouncing and *trasflorar* methods could have been used for multiple copies, saving time. It was likely the square-grid method would have been undertaken only to alter the scale, and probably would have taken even more time than all others. Further experimentation would need to be completed to confirm this assessment.

The experiment determined that copying the toponymy was the most time-consuming utilitarian aspect of the process, taking an average of thirty seconds per place-name. Furthermore, it was discovered that copying quickly resulted in misspellings, whereas duplication of some letter forms, and conservation of the orientation of words, was the most efficient method; it would not have been worth the extra time for a copyist to alter a system that had already worked. As a result, comparison of patterns of word orientation might reveal unknown exemplar-copy links between portolan map-makers.

The discussion of scale and latitude revealed the considerable variation in the scales used, and also how imprecisely they were drawn, both of which are not indicative of a utilitarian function. The reproduction of decorations in the experiment indicated that ornamentation of a portolan map could take longer than every other stage combined. At the very least though, all islands were coloured to aid in visualising the hydrography. Although the experiment can be considered successful, more work must be done to test other methods, and to verify the times determined for each constituent process.

Taking into account information gleaned from the reconstruction experiment, and the discussion above, it is apparent that a chart of the Mediterranean without decoration could be made in two weeks, and if including the Atlantic and Black Sea, probably three weeks at a diligent pace. Decoration would have taken a long time depending on quality and extent, potentially longer than the rest of the entire chart-making process. One can only estimate the production time for an atlas, but they would probably have taken longer than a single chart covering the same area, due to hydrographic overlapping between map-folios. Although it has been suggested that a large and well-organised workshop could reduce production times, there is little evidence that this was the case. Finally, it is highly unlikely that a professional chart-maker would have produced thousands of maps in his lifetime, and indeed many of the makers only appeared to make portolan maps on a part-time basis. This reconstruction experiment has provided unique practical insight concerning the production of portolan maps, and indicates that the theory they were necessary for navigation and produced in great numbers is questionable.

II: Analysis of Seven Case Studies

Introduction and Methodology

The first chapter analysed the production methods that would have been used to manufacture portolan maps. In addition to detailing their constituent aspects, such as the rhumb network, hydrography, toponymy, and decoration, it was established that most charts were copies from exemplars, and that they were neither quick nor easy to produce. This chapter will thoroughly examine and discuss seven extant portolan maps and their makers, with the aim being to evaluate their specific functions, and position within the genre. The case studies chosen were the following:

- **1320 Petrus Vesconte Atlas** (Rome: BAV, Pal. Lat 1362A)
- **1339 Angelino Dulceti Chart** (Paris: BN, Rés. Ge. B 696)
- **1403 Franciscus Becharius Chart** (New Haven: BRBML, Art Storage 1980.158)
- **1465 Petrus Roselli Chart** (London: BL, Eg. 2712)
- **1468 Gratiosus Benincasa Atlas** (London: BL, Add. MS. 6390)
- **1489 Albinus de Canepa Chart** (Minneapolis: JFBL, B1489mCa)
- **1567 Jacopo Maggiolo Regional Chart** (Rome: BNC, Carte nautiche, 5)

The case studies were selected according to the following criteria: first, that they date from across the timespan of the genre; second, that they were made by different cartographers of different nationalities in different locations; third, that the maps each have at least one particular characteristic which is different to the other case studies, but still representative of many surviving charts, e.g. extensive vexillography, unusual hydrography, etc.; fourth, that there is some published scholarship on each chart-maker; and fifth, that each map was accessible to consult, or at least that a high-quality facsimile could be obtained.[1]

[1] Not every chart analysed in this thesis was accessible for direct consultation and analysis. However, a compromise had to be made between limiting the case studies to ones available for personal examination in the UK, and ones that better fit the other criteria outlined. For example, it was vital that the Jacopo Maggiolo chart from 1567 was included in this study, because it has been considered by some scholars to be the only entirely surviving chart actually used at sea, and thus of great importance to this thesis.

The evaluation of each case study will not only focus on the particular chart in question, but also on the chart-maker, his corpus of other maps, and the history of the place of production. The aim of each is to investigate the purpose of the map through an evaluation of its utilitarian and non-utilitarian aspects. Furthermore, the case studies will compare the maps with others by their maker to determine how representative the chart was, to understand the sort of cartography produced, and will seek to determine how the map fit into the genre of portolan cartography overall.

Although most scholars of portolan maps have opted for a thematic approach, i.e. discussing the hydrography of all the maps, then decoration, then toponymy etc.,[2] this method risks the assessment of only selective aspects of a number of individual maps, without thorough analysis of each map and maker individually. A more substantial analysis of a smaller number maps will be able to uncover (albeit individually) their true function and purpose. The results gleaned will then be synthesized with other scholarly research in a more thematic way in Chapter IV, where an assessment will be made about the functions of the entire genre.

[2] For instance: Campbell, Tony: 'Portolan Charts from the Late Thirteenth Century to 1500', in *The History of Cartography*, ed. by J. B. Harley and David Woodward, 3 vols. (Chicago: UCP, 1987), vol. 1, pp. 371-463; Pujades i Bataller, Ramón J. : *Les cartes portolanes: La wjuwjxjsyfhn¼ rjinj{fq iúzsf mar solcada*, trans. by Richard Rees (Barcelona: Institut Cartogràfic de Catalunya, Institut d'Estudis Catalans, Institut Europeu de la Mediterrània, 2007) ; Astengo, Corradino: 'The Renaissance Chart Tradition in the Mediterranean', in *The History of Cartography*, ed. by David Woodward, 3 vols. (Chicago: UCP, 2007), vol. 3, pp. 174-262.

The 1320 Atlas of Petrus Vesconte

The First Known Chart-Maker

Of extant portolan charts and atlases, two anonymous charts are generally accepted as the earliest survivors: the *Carte Pisane*, thought to be of Genoese authorship and made sometime during the last quarter of the thirteenth century (c.1290), and the 'Cortona Chart' which certainly dates to the first half of the fourteenth century, but most likely before 1311.[3] The first signed extant map is the 1311 chart drawn by Petrus Vesconte. Little is known about the life of Vesconte, and no scholar has been able to successfully identify him in contemporary documents.[4] He identified himself as "de Janua" in the signatures on his maps, but was working in Venice from at least 1318 when he wrote in an atlas: "Petrus Vessconte d'Janua fecit istam tabula i<u>n</u> venecia. anno d<u>omi</u>ni m.ccc.xviii".[5] A second undated (but later) atlas also stated: "i<u>n</u> venecia" though most of the rest of the signature has been deliberately erased.[6]

Most of what can be inferred about Vesconte comes from Marino Sanudo, author of the *Liber secretorum fidelium crucis super Terrae Sanctae recuperatione et conservatione* ('Book of secrets for faithful crusaders on the recovery and retention of the Holy Land'), for whom Vesconte made the portolan maps which accompanied copies of his books. The book was a detailed plan designed to convince the Pope and courts of Europe to launch another crusade, following the fall of Acre to the Mamluks on 28 May, 1291. Maps were included for various reasons, which will be discussed in greater detail below.

The Sanudi, into which Marino was born around 1270, were one of the old patrician families of Venice, and had acquired a prominent duchy in the Aegean in the late twelfth century when a Sanudo married the sister of Enrico Dandolo.[7] Increased trade routes with the east following the Fourth Crusade (1202-1204) contributed to the growing fortune and estates of the family, especially on Naxos.[8] Marino's father was a member of the Venetian

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[3] Campbell: (1987), pp. 403-404.

[4] Pujades mentioned a Genoese document dating to 1327 referring to a surgeon named 'Pietro Visconti', but dismissed this as most likely a different individual. Pujades i Bataller: (2007), p. 489.

[5] Venice: Museo Correr, port. 28, f. 2v.

[6] Lyons: Bibliothèque de la Ville, MS. 175, f. 4r.

[7] Lock, Peter: 'Introduction', in *The Book of the Secrets of the Faithful of the Cross* (Farnham: Ashgate, 2011). p. 1.

[8] Edson, Evelyn: 'Reviving the crusade: Sanudo's schemes and Vesconte's maps', in *Eastward Bound: Travel and travellers, 1050-1550*, ed. by Rosamund Allen (Manchester: Manchester University Press, 2004), pp. 131-155. p. 132.

Senate, and Marino was well-travelled; he visited Acre in 1285 and possibly again before 1291.[9]

Although there is no written documentation about Petrus Vesconte, he must have been well-acquainted with Marino Sanudo; Harvey commented that he must have been from a good family,[10] and he was probably well-known to the Doge and Senate. Crone noted that Vesconte was consulted by the authorities when the first fleet of 'Flanders galleys' was being organised shortly before 1317.[11] His connections with the Venetian merchant fleet trading in Flanders and Southampton is reinforced by his maps, which displayed an improved hydrography of England compared with the *Carte Pisane*. The luxuriousness of his atlases additionally supports the notion that his patrons were wealthy and erudite.

Pujades i Bataller presented evidence that Vesconte was an artist by trade. He argued that whereas some portolan maps contain areas left blank to be painted-in later,[12] the decoration on Vesconte's atlases was so well-incorporated that he must have done it himself. The corner portraits – a hallmark of Vesconte's atlases – were always included on the corners of every map unless it interfered with the hydrography, and they all appear to have been painted by the same artist.[13] Pujades discussed the palaeography of Vesconte's scribal 'hand' and his inelegant use of Latin, and theorised that he would have trained within the socio-professional realm of notaries and merchants rather than the more learned ecclesiastical/university circle.[14] While this is probable, it does not indicate Vesconte was not engaged with the Venetian elite on a regular basis.

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[9] Ibid. ; Lock, Peter: 'Introduction', in *Marino Sanudo Torsello: The Book of the Secrets of the Faithful of the Cross* (Farnham: Ashgate, 2011). p. 9.

[10] Harvey, P. D. A.: *Medieval Maps of the Holy Land* (London: BL, 2012). p. 113.

[11] Crone, G. R.: *Maps and Their Makers: An Introduction to the History of Cartography*, 5th edn. (Folkestone, Kent: Dawson; Hamden, Conn.: Archon Books, 1978). p. 37.

[12] Pujades cited as evidence three atlases – one anonymous, and two by Gratiosus Benincasa – with unpainted corners: Pujades i Bataller: (2007), pp. 490, 503 (note 67). However, there is no evidence that the corners on these atlases were ever meant to be decorated. In fact, the only instances in which areas were deliberately left blank to be filled in later are the empty heraldic shields on the Battista Agnese atlases, which were probably filled in by his own assistants (or himself) when a particular buyer was found. There is little to no evidence that portolan map-making and decoration were completed by separate parties.

[13] Ibid. pp. 489-490.

[14] Ibid. p. 489.

The Maps of Petrus Vesconte

The surviving corpus of Vesconte's signed works includes one chart made in 1311, and five atlases made in: 1313, 1318 (2), 1320, and c.1322.[15] Konrad Kretchmer in 1891 was the first to demonstrate the connection between Petrus Vesconte and Marino Sanudo.[16] He concluded that the unsigned nautical maps from two copies of the *Liber secretorum fidelium crucis*[17] were also likely the work of Vesconte, a conclusion most scholars now accept.[18] The six-map Vatican atlas is generally thought to be from one of the two copies of the book Sanudo presented to Pope John XXII in Avignon in September 1321.[19] Conversely, the nine-map British Library atlas is still bound with a later copy of the *Liber secretorum*, and estimated to date to roughly 1325. Of Vesconte's signed works, the atlas dated 1320[20] contains (in addition to five portolan charts) a world map, a grid map of Palestine, and city plans of Acre and Jerusalem, nearly identical to those found in either or both of the two unsigned *Liber secretorum* atlases. It was likely bound with Sanudo's text at some point, and was possibly the second of the two copies Sanudo presented to the Pope.[21]

A further atlas, dated 1321, and a chart dated 1327, were signed 'Perinus Vesconte'. Nordenskiöld surmised that Petrus and Perinus were the same map-maker, and that the latter name was merely a diminutive form.[22] However, others have proposed that Perinus was a younger relative of Petrus, trained to be his successor.[23] This opens the possibility

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[15] Campbell: (1987), p. 406. These are: (1311) Florence: Archivio di Stato, CN1; (1313) Paris: BN, Rés. Ge. DD 687; (1318) Venice: MC, Port. 28; (1318) Vienna: Österreichische Nationalbibliothek MS. 594; (1320) Vatican City: BAV, Pal. Lat. 1362A; (c. 1322) Lyons: Bibliothèque de la Ville, MS. 175.

[16] Kretschmer, Konrad: 'Marino Sanudo der Ältere und die Karten des Petrus Vesconte', *Zeitschrift der Gesellschaft für Erdkunde zu Berlin*, 26: 4 (1891), 352-370. pp. 352-370; Harvey: (2012), p. 112.

[17] Rome: BAV, Vat. Lat. 2972; London: BL, Add. MS. 27376.

[18] Edson: (2004), p. 137.

[19] Campbell: (1987), p. 406; Edson: (2004), p. 134.

[20] Rome: BAV, Pal. Lat. 1362A.

[21] Edson (Ibid. pp. 136-137) noted this possibility was first proposed by Degenhart and Schmitt: 'Marino Sanudo und Paolino Veneto: Zwei Literaten des 14. Jahrhunderts in ihrer Wirkung auf Buchillustrierung und Kartographie in Venedig, Avignon und Neapel', *Römisches Jahrbuch für Kunstgeschichte*, 14 (1973), 1-137.

[22] Nordenskiöld, A. E.: *Periplus: An Essay on the Early History of Charts and Sailing-Directions*, trans. by Francis A. Bather (Stockholm: P.A. Norstedt, 1897; repr. New York: Burt Franklin, 1964). p. 58 (note 14).

[23] Revelli, Paolo: *Cristoforo Colombo e la scuola cartografica genovese* (Genoa: Consiglio Nazionale delle Ricerche, 1937). p. 268, as cited in: Campbell: (1987), p. 407; Falchetta, Piero: *Marinai, mercanti, cartografi, pittori: richerche sulla cartografia nautica a Venezia (sec. XIV-XV)* (Venice: Atento Veneto, 1995). pp. 29-37; Pujades i Bataller: (2007), p. 487 (note 38); Harvey: (2012), p. 113.

that the anonymous charts in the Vatican and British Library copies of Sanudo's *Liber secretorum* were in fact by Perinus and not Petrus. Andrews proposed that the portolan charts in the c.1325 British Library copy of the *Liber* were drawn by Perinus due to the hydrographic similarities between it and the signed 1327 chart.[24] It is possible that some copies of the *Liber secretorum* maps were made by Petrus while others were made by Perinus, especially in later copies after Perinus had (presumably) taken over the atelier. Edson noted that not all copies of the *Liber* were sent with maps included, which were expensive additions, but that in some letters, Sanudo wrote that he would send maps if requested.[25]

Assuming that Petrus was the predecessor of Perinus, and that the two surviving anonymous sets of *Liber secretorum* maps were by his hand, a total of one chart and seven atlases are attributed to him, though doubtless this is but a small fraction of his total output. The atlases can be divided into two groups: four standard atlases and three *Liber secretorum* atlases, which due to their differing purposes, will be discussed separately. First, however, it is worth discussing the 1311 chart and how it differed from the two earliest anonymous maps.

The Chart of 1311

The only extant portolan chart by Petrus Vesconte is likely the third oldest in existence and it is the oldest with a confirmed date, signed "Petrus vesconte de Janua fecit ista carta ann (sic) domini •m• ccc xj."[26] Without stating the location of manufacture as he did with his atlases, and without documentary evidence of Vesconte's whereabouts at the time, it is impossible to prove the chart's provenance. The

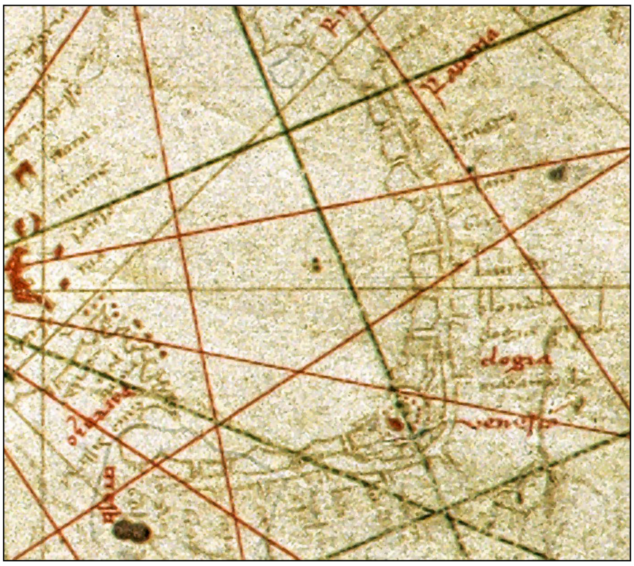

Figure 2.1.1: The northern Adriatic Sea from Vesconte's 1311 chart in Florence: AS, CN1. Image from Pujades i Bataller (2007) DVD Supplement.

[24] Andrews, Michael C.: 'Scotland in the Portolan Charts', *Scottish Geographical Magazine*, 42: 3, 4, 5 (1926), 129-153, 193-213, 293-306. p. 136.

[25] Edson: (2004), p. 151.

[26] The chart is in Florence: Archivio di Stato, CN1. There is a second signature on the chart which may have been added later (certainly it was written in a different hand), but more prominently on the neck of the chart.

map measures 42 cm x 52 cm, and has a scale of 1.0 cm to 50 *miglia*. Aligned with its neck to the east, the map covered only the Black Sea and the eastern/central Mediterranean including Corsica and Sardinia, with Genoa on the periphery. Given Genoa's strong trading links with the east at this time, the hydrographic coverage is no indication of provenance. However, the drawing of the Venetian archipelago and the swampy lagoons of the northern Adriatic between Ravenna and Trieste (which were a hallmark of his maps), demonstrate that Vesconte was familiar with the hydrography of the area, indicating he was already in Venice by this time. Not only is the chart the earliest extant signed map, it was also the first to be decorated, with a chevron border of alternating colours, decorated river deltas and islands, and coloured scale circles.

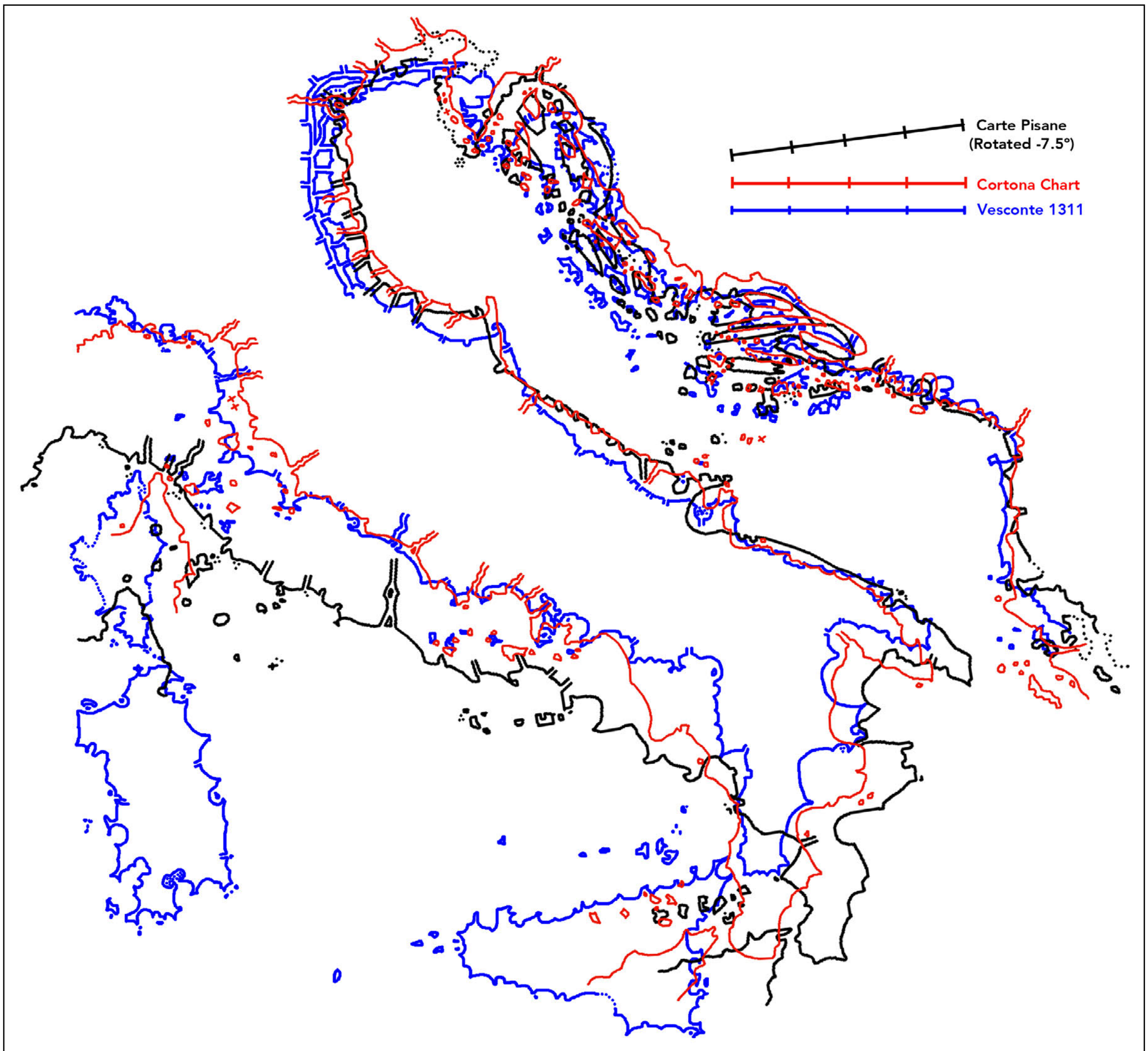

Figure 2.1.2: Three superimposed coastlines, traced from the *Carte Pisane*, Cortona Chart, and the 1311 Vesconte Chart. Note the *Carte Pisane* had to be rotated 7.5° to the west for the littoral to align correctly. Traces were completed digitally using images taken from: Pujades i Bataller (2007) DVD Supplement.

Within these formative years of the genre of portolan chart-making, cartographic lineage (i.e from whom Vesconte copied his maps) is difficult to establish. Hydrographic comparison between the chart of 1311, the *Carte Pisane*, and the Cortona chart, reveals the similarity of the Adriatic Sea, which was elongated by roughly ten percent more than it should have been.[27] Figure 2.1.2 depicts the three coasts, superimposed upon each other, and aligned at Venice. Other than the shape and size of the Adriatic, there would appear to be little resemblance between the *Carte Pisane* and Vesconte's chart. However, more likeness can be seen between the Cortona chart and Vesconte's, and thus it is plausible the two are linked, though a direct 1:1 copy is unlikely.

The Standard Atlases

In all four of Petrus Vesconte's surviving standard atlases, the first opening depicted an elaborate circular calendar diagram, an example of which is shown in figure 2.1.3. In the corners, these were illuminated (in all but the 1313 atlas) with portraits of the four evangelists: Matthew, Mark, Luke, and John as the man, winged lion, ox, and eagle respectively. It is possible Vesconte deliberately choose to use the symbols of the evangelists; Venice's heraldic emblem is the winged lion of St Mark, and undoubtedly these saintly portraits would have been popular with purchasers. The 1313 atlas, unlike the other three, was not quite as lavishly decorated and did not include the evangelists, but retained the calendar including an explanatory paragraph concerning its use. Unfortunately now nearly

Figure 2.1.3: Elaborate illuminated calendar from Vesconte's 1318 Atlas in Vienna: ONB, MS. 594, ff. 1v-2r. Image from: Pujades i Bataller (2007) DVD Supplement.

[27] Not until the 1330 chart of Angelino Dulceti was the length of the Adriatic shortened to its more correct size.

indiscernible, the 1313 atlas included decorations of the twelve zodiac symbols inside the calendar. On the later three atlases, the inside of the calendar instead contained a chart of the zodiac stations for each 29.5-day lunar cycle.

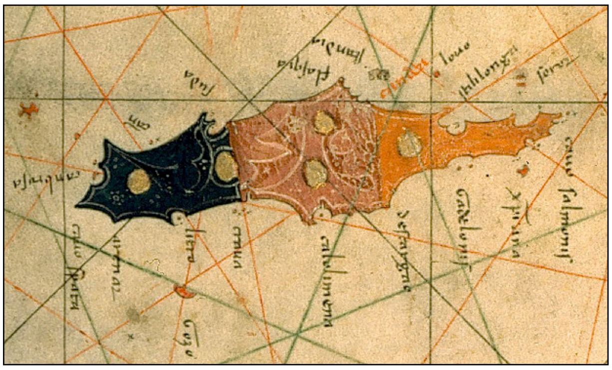

Figure 2.1.4: Crete from Vesconte's 1313 atlas in Paris: BNF, Rés. Ge. DD687, f. 4v. Image from: Pujades i Bataller (2007) DVD Supplement.

The number of maps within the four standard atlases varied between five in the 1313 atlas to nine in the 1318 atlas, but Petrus generally followed a consistent pattern. The Black Sea was depicted first, followed by the Aegean, then the Adriatic (which may also have been inserted at the end), then the Mediterranean in two or three sections from east to west, and finally the Atlantic European coastline. Usually the Adriatic and Aegean seas were drawn at a larger scale than the other maps. Cartometric measurements made by Pujades indicate that Vesconte adhered to consistent scales: maps of the central and western Mediterranean were drawn at either 1.0cm or 0.7cm/50 *miglia*, and 1.3cm/50 *miglia* was the scale for maps of the Adriatic and Aegean seas.[28] However, examination of the hydrography of the same regions from different atlases shows inconsistency: for example, the coastlines from the maps of the eastern Mediterranean do not begin and end at the same location, which could be an indication that Petrus directly copied the atlas pages from a full-sized chart exemplar, or used the square-grid method to visually transfer the hydrography, but did not copy exemplar atlas pages for each distinct region, which would have resulted in identical (or nearly identical) maps in each atlas.

Besides the initial calendar pages, the maps of all four atlases were decorated: the earliest 1313 atlas depicted illuminated river deltas and major islands, such as Crete, and also featured brief explanatory texts of geography and anthropology, the first portolan map to do so. The 1318 Venice atlas included illuminated portraits of angels and saints in the corners except where they would interfere with the maps. However, the 1318 Vienna atlas did not include saints' portraits except on the calendar, but instead included a multi-coloured chevron border, and decorated corners and scale bars depicting wyverns and vegetation. In the c.1321 Lyons atlas, Vesconte drew a single wyvern underneath his

[28] Pujades i Bataller: (2007), p. 207.

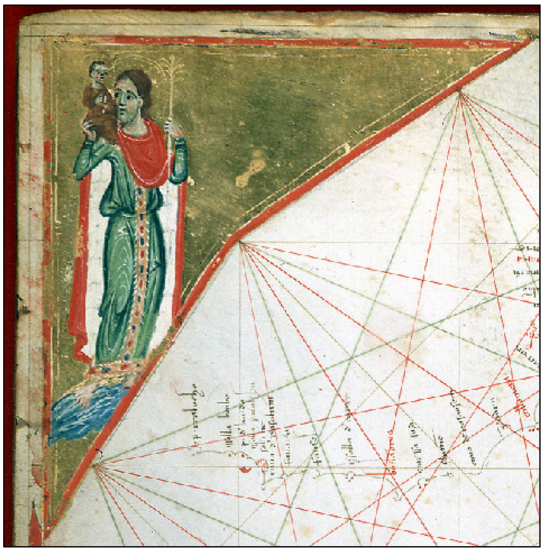

Figure 2.1.5: The infant Jesus with St Joseph, appearing on Vesconte's 1321 atlas in Lyon: BM, MS. 175, f. 5v. Image from: Pujades i Bataller (2007) DVD Supplement.

signature, and depicted religious figures around each map, several of which were labelled.[29] A selection of these same religious portraits appear in the five-map Perinus Vesconte atlas of 1321, which are so similar that although signed by Perinus, Petrus may have still been the painter of the corner portraits (if they were in fact two different people).

Given their expensive decoration, these atlases (and presumably some charts) would have been constructed for wealthy patrons to purchase, but it is questionable whether they were individually commissioned or made as stock. Certainly, evidence from later in the fourteenth and fifteenth centuries indicates that both occurred in the production of

Figure 2.1.6: Three coastlines traced from the *Carte Pisane* (top), Cortona Chart (middle), and the 1311 Petrus Vesconte chart (bottom). Traces were completed digitally using images taken from: Pujades i Bataller (2007) DVD Supplement.

[29] These include: St John the Baptist, St Julian, St Anthony, St George, St Francis, St Dominicus, St Lawrence, St Clare, St Erasmus, St Lucia, St Nicolas, St Peter, and St Andrew. Gabriel and the Virgin Mary were depicted on folios 8v-9r, and on folio 5v, there is a depiction of Jesus as a child with St Joseph holding a staff with lilies.

portolan maps, but in this early period it is difficult to establish Vesconte's pace of output, popularity, and whether or not he was a full time cartographer. It is certainly debatable how many portolan maps would have been in circulation in the early fourteenth century, whether this genre of cartography was still in its infancy, or already well-established and prolific. The significant hydrographic differences between the *Carte Pisane*, Cortona chart, and the first chart by Petrus Vesconte, as indicated by the coastlines in figure 2.1.6, demonstrate that significant changes were still being made, which is in stark contrast to the later fourteenth century (and onwards) during which alterations were rare, even if they were improvements.[30] This, combined with the scarcity of surviving maps or other known cartographers during this period, suggests the genre was not yet nearly as prolific as it would become in the fifteenth century.

The surviving portolan maps indicate that Petrus Vesconte was an innovator in several ways: he was the first to combine the marine charts into an atlas form, the first to add textual explanations, the first to significantly decorate, and the first to depict flags on his maps. However, it is possible that other map-makers introduced these aspects earlier, who are now lost to history. Vesconte, more assuredly, was the establisher of the scale in a standard format that would be used from his maps onwards: whereas his 1311 chart and 1313 atlas depicted a circular scale similar to those found on the *Carte Pisane* and Cortona chart, from 1318 he included what became the standard portolan chart scale bar.

The hydrographic style of Vesconte was also adopted by later cartographers. In the preceding figures, while the *Carte Pisane* and Cortona chart do not depict exaggeration of the individual bays and headlands, the 1311 Vesconte chart shows a hyperbolic coastline, which became the standard for nearly all future portolan charts. Whether or not this was a conscious decision, or a product of the method of copying is debatable,[31] but nevertheless, Petrus Vesconte was in many ways the father of several standards in portolan map creation. It is possible that the genre did not become widely popular, at least as luxury aesthetic items, until after the popularisation of these maps to Europe's elite by Marino Sanudo.

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[30] Portolan map-makers were however keen to add new discoveries to their established *œcumene*. The first cartographer to make any significant alteration to the established cartography was Franciscus Becharius in 1403, which is discussed in further detail below.

[31] As discussed in Chapter I, Peter Pelham first posited the possibility that the hyperbolic coastlines were a result of the copying process. Pelham, Peter Thomas: 'The Portolan Charts: Their construction and use in the light of contemporary techniques of marine survey and navigation' (Unpublished MA Thesis, Victoria University of Manchester, 1980). pp. 90-91.

The Liber Secretorum Maps

As discussed above, Marino Sanudo wrote and disseminated the three books of his *Liber secretorum fidelium crucis* to encourage the Pope and the monarchs of Europe to begin another crusade to recapture the Holy Land following the fall of Acre in 1291. This was to be accomplished through economic warfare against Egypt until it could be secured, before moving to the Holy Land. Marino was only one of numerous people campaigning for a new crusade following the 1274 Council of Lyons and the fall of Acre in 1291: Peter Lock wrote that nearly thirty different treatises advocating a crusade were identified by Antony Leopold.[32] Nor was Marino the only one to include maps: two maps of the eastern Mediterranean survive in Fidenzio da Padova's c.1291 *Liber recuperationis Terrae Sanctae*, and though no maps survive in the only extant copy of Galvano da Levanto's post-1291 *Liber Sancti passagii christicolarum contra Sarracenos pro recuperatione Terre Sancte*, some copies are thought to have contained maps.[33] Despite the number of campaigns, several scholars have agreed that Sanudo was among the most persistent, and his plan the most practical and well-developed.[34]

Although his campaign was ultimately unsuccessful, numerous copies of the *Liber secretorum* were circulated around Europe, several of which featured maps by Vesconte. Nineteen complete texts and a further four fragments of the *Liber* survive, which must have been only a fraction of the total.[35] Of these, nine contain maps, two of which include portolan charts, unsigned but generally attributed to Vesconte. A further four bound atlases contain maps that were once associated with the text of the *Liber*, and of these one is the signed 1320 atlas of Petrus Vesconte.[36] Sanudo did not include maps with every copy, but it is impossible to know what percentage contained them. In a letter to John of Limburg in 1324, Sanudo wrote that he could send maps if required.[37] Undoubtedly the maps were expensive to reproduce, and were included primarily with more lavish copies of the book

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[32] Lock: (2011), p. 12.

[33] Harvey: (2012), p. 107 (note 1); Gautier-Dalché, Patrick: 'Levanto, Galvano da', Dizionario Biografico degli Italiani, vol. 64, (2005) <http://www.treccani.it/enciclopedia/galvano-da-levanto_(Dizionario-Biografico)/> [accessed 5 September 2013]; Simonelli, Fabio: 'Fidenzio da Padova', Dizionario Biografico degli Italiani, vol. 47, (1997) <http://www.treccani.it/enciclopedia/fidenzio-da-padova_(Dizionario-Biografico)/> [accessed 5 September 2013].

[34] Harvey: (2012), p. 107; Edson: (2004), p. 135; Lock: (2011), p. 12.

[35] Ibid. pp. 14-15.

[36] A comprehensive list of these nine copies of the *Liber* and four unassociated atlases, and their contents is given in: Edson: (2004), pp. 151-152.

[37] Lock: (2011), p. 16.

sent to the most wealthy and powerful patrons who were thus potentially more able to aid in the crusade.

In a letter dated 1332 to King Philip VI of France, Sanudo wrote: "Whosoever exercises the leadership of the crusade must wholeheartedly follow the directions as proposed in the *Book of Secrets* … and pay very careful attention to the maps showing Egypt, the Mediterranean and the Holy Land."[38] There are several probable reasons why Sanudo chose to include maps in his *Liber secretorum*: maps of any sort at this time were rare and costly, so their inclusion in the *Liber* demonstrated Sanudo's wealth, seriousness, passion for his campaign, and his erudition. In presentation copies, the aesthetics of the maps would have made the recipients of the *Liber* more likely to display and promote it to others. The maps would have also had a didactic purpose: by visually depicting the regions discussed in the text to the reader, they would not only better understand the proposed crusade, but feel more morally obliged to act.

Sanudo was clever in his combination of included maps; while in the text he only mentioned four – "one of the Mediterranean Sea, the second of the sea and the land, the third of the Holy Land, the fourth of the land of Egypt"[39] – ten of the thirteen associated atlases included a world map, ten included a city map of Jerusalem, seven a city map of Acre, and three a city map of Antioch. Harvey demonstrated that, at least in the case of Vesconte's 1320 atlas, all ten included maps were drawn in Vesconte's workshop.[40] The world map would have shown the growth and extent of Islam, which outstretched Christianity at this time, and the inclusion of city maps prompted the recipient of the *Liber* to reflect upon the fall of these great cities to the infidel.

Sanudo also had personal and state benefit in mind: while he claimed to be campaigning through his own volition,[41] scholars have suggested he had been operating at the behest of the Venetian republic, and certainly Venice had much to gain by securing Egyptian trade routes and retaking the Holy Land.[42] Thus, not only did Sanudo need to

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[38] Original translation in: Frankfort, Frank: 'Marino Sanudo Torsello: A social biography' (Unpublished Doctoral Thesis, University of Cincinnati, 1974). p. 223. Cited in: Edson: (2004), p. 151.

[39] Sanudo Torsello, Marino: *The Book of the Secrets of the Faithful of the Cross*, trans. by Peter Lock (Farnham: Ashgate, 2011). p. 1.

[40] Harvey: (2012), p. 112.

[41] "For I am not directed to you by any king, prince or commonwealth or by any other special person, but entirely at my own free will…" Sanudo Torsello: (2011), p. 2.

[42] Edson: (2004), pp. 132-133, 150 ; Lock: (2011), p. 10.

convince the courts of Europe to crusade, but to follow his plan rather than any other, and the maps were intended to convince them as such.

Unfortunately, nothing is known about the relationship between Vesconte and Marino except what can be gleaned from the surviving maps. Only three of the thirteen surviving compilations of maps include portolan charts by Petrus Vesconte, two of which were presented to the Pope, and the other of which is currently in London but of unknown initial ownership. There is disagreement as to whether Vesconte was the author of all the maps, or only the portolan charts: Kretchmer believed that all the maps were from the Vesconte atelier, whether by Petrus or Perinus, and both Lock and Edson supported this conclusion.[43] However, Dilke argued that the grid maps of Palestine were not made by Vesconte, that the city map of Jerusalem was copied from Burchard of Mount Sion, and Acre was based on Sanudo's own personal knowledge.[44] Harvey posited that while some maps were not in either Petrus' or Perinus' hand, their quire construction indicates they were compiled at the same time in the same workshop.[45] In the signature of the 1320 atlas discussed below, there is a word beginning 'qua'. Harvey posited that this was the beginning of 'quaternam' meaning 'quire', demonstrating that Vesconte was responsible for all the maps in the atlas, even if some of the writing was not in his hand.[46] Multiple cartographers might have been employed in an atelier to produce the maps, although whether that workshop belonged to Vesconte or another is debatable. A more detailed palaeographical analysis could identify all the different scribal hands throughout the surviving maps, which might better illuminate their production.

The 1320 Atlas of Petrus Vesconte

Without the 1320 atlas,[47] there would have been little evidence to suggest Petrus Vesconte's involvement with the *Liber secretorum*. Sanudo made no mention of Vesconte in the book, or in any letters. Although the atlas is not currently associated with a surviving manuscript copy of the *Liber*, the maps in it are nearly identical to those found in BAV, Vat.

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[43] Ibid. pp. 15-16 ; Edson: (2004), pp. 138-152.

[44] As cited in: Lock: (2011), p. 15.

[45] Harvey: (2012), p. 112. In the 1320 atlas (Rome: BAV, Pal. Lat. 1362a), the recto side of folio seven is clearly a Vesconte portolan chart, whereas the verso side is the northern half of a grid map.

[46] Ibid.

[47] Rome: BAV, Pal. Lat. 1362a.

Lat. 2972, one of the two copies of the *Liber* presented to the Pope by Sanudo. As noted above, Degenhart and Schmitt have surmised that it might have been from the second of the two presentation copies given to Pope John XXII in Avignon in September 1321.[48]

The atlas is comprised of the following ten maps:

✤ Folios 1v-2r: *Mappamundi* with textual supplement. Given the orientation of the text, the map is intended to be read rotated 90° clockwise, in which case east is at the top of the map as expected.

✤ Folios 2v-3r: Portolan chart of the Black Sea decorated with ten flags and a coloured Danube river delta.

✤ Folios 3v-4r: Portolan chart of the Aegean and central Mediterranean, decorated with three flags. Also contains the signature of Petrus Vesconte.

✤ Folios 4v-5r: Quasi-portolan chart of the eastern Mediterranean, with internal geography of Egypt, Syria, and Mesopotamia. Undecorated but includes drawings of cities and towers with textual explanations.

✤ Folio 5v: Portolan chart of the Adriatic Sea, decorated with four flags.

✤ Folio 6r: Portolan chart of the western African Mediterranean coastline and southern Iberia, decorated with five flags.

✤ Folios 6v-7r: Portolan chart of the westernmost African Mediterranean, Iberia, the Atlantic coast of France, and the British Isles, decorated with five flags. Notably this is the earliest portolan map depicting Ireland, though no toponyms were written on the island.

✤ Folios 7v-8r: Map of the Holy Land from Sidon in the North to Gaza in the south, covered in a pencil grid measuring eighty-three leagues (one per square) from north to south and twenty eight from east to west. Sea and lakes were painted green, and mountains brown, but otherwise undecorated except for a few small city illustrations. Textual accompaniments to the map were written underneath and on the map itself.

48 Edson: (2004), pp. 136-137.

- ✤ Folio 8v: City map of Jerusalem, not drawn to consistent scale, but considerably more realistically mapped than the traditional circular symbolic depiction. Also includes the Garden of Gethsemane and Mount of Olives, but largely undecorated.

- ✤ Folio 9r: City map of Acre before 1291, depicting a reasonably accurate layout of the four sectors (Venetian, Genoese, Pisan, and German), roads, and major buildings. Not decorated except for the drawings of buildings, and a single flag above the Venetian castle.

Each folio of the atlas measures between 45-47 cm tall and 28-30 cm wide, but these have been trimmed by at least a centimeter (probably more) around all sides, as revealed by the clipped signature on f. 3v, and the missing outer scale edges on numerous folios. All the maps appear to use the same brownish-black ink (carbon-black), and the same orange-red ink (probably *minium*). Unlike most portolan atlases, the maps were drawn on both sides of the parchment, rather than only the flesh side and attached to boards, the reason being that they formulated a quire designed to be inserted into a codex, rather than an independent atlas. It is for this reason that all the different maps were probably made in the same workshop, even if they were not by the same cartographer; most of the maps were drawn across two folios but not the same sheet, thus the parchment quire must have been bound together first, and each map drawn one after another.

Harvey concluded that the non-portolan maps in this atlas were not made by Vesconte.[49] Palaeographical examination of the maps supports this assessment, though Vesconte could have been responsible for the map drawing if not the toponymy. The scribal hand responsible for the *mappamundi*, grid map and city maps is more squat, thick, and formalised than the script of Vesconte, with differing letter forms, and moreover, the spelling differs considerably on each map. Future palaeographical examination might be able to determine the number of hands that contributed to the atlas, and verify if any of them match that of others known to be or possibly involved, such as Sanudo or Perinus, or possibly Paolino Veneto, whom Harvey noted knew Sanudo and probably Vesconte as well.[50]

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[49] Harvey: (2012), p. 112. It is outside the scope of this thesis to evaulate the non-portolan maps in the atlas. For a thorough analysis of the grid map of the Holy Land, see: Ibid. pp. 107-127 esp. 108-113, 120-121. For a discussion of the world map and city maps, see: Edson: (2004) esp. 138-139.

[50] Harvey: (2012), p. 113.

Date and Signature

The signature is written on f. 3v: "Petrus Vessconte d' Ia[…] fecit istam cartam uel qua[…] anno domini • mº cccº • xx •". A few scholars, such as Roberto Almagià, have surmised that the atlas could be dated later than 1320, given that the edge of the folio has been trimmed.[51] However, Tony Campbell surmised that because the 1320 atlas is less well-developed than the atlas in the *Liber* presented to the Pope in 1321 (Vat. Lat. 2972), it was an earlier drafting.[52] Hitherto unnoticed, Petrus always wrote the year in his signatures in a specific way: there was a significant space between the 'm', 'ccc', and the rest of the year, i.e. 'xviii'. Often, large dots were placed between these three numerals, but Petrus never divided the 'x' from the (for instance) 'viii'. Given that a dot can be clearly seen after the 'xx' in figure 2.1.7, the date of the atlas is assuredly 1320.

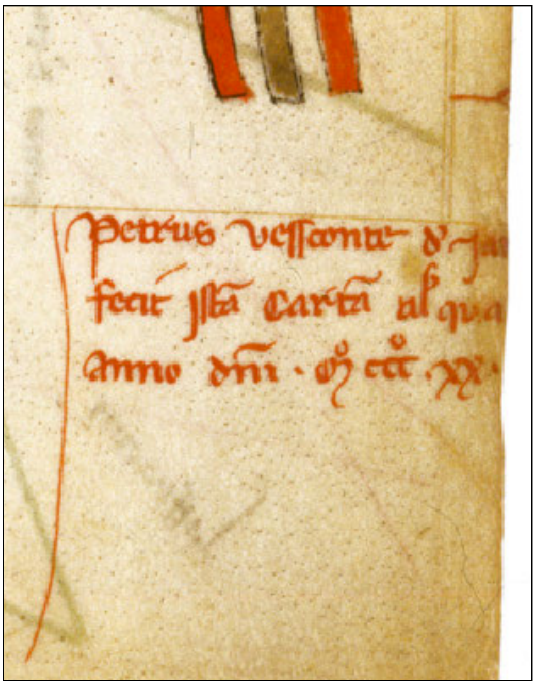

Figure 2.1.7: Signature from Petrus Vesconte's 1320 atlas: Rome: BAV, Pal. Lat. 1362a, f. 3v. Image from: Pujades i Bataller (2007) DVD Supplement.

Hydrography

Curiously, the hydrographic coverage of the portolan maps is missing a very large section of the central Mediterranean, not absent in the other atlases, from Taranto to Tarragona. On the other two atlases of *Liber* portolan charts, this region is drawn on a smaller scale map than any within the 1320 atlas and covers the central/west Mediterranean from the Adriatic to the Balearics. There is no reason that this region would have been deliberately left out, especially when it included Rome and Avignon, especially if the atlas was one of the two presented to the Pope. It seems that at some point, before the folios were numbered in pencil, the central-most leaf of the quire, between what is now 5v and 6r, was removed. As shown in Figure 2.1.8, this would explain the fact that 5v and 6r are not part of the same mapped area, and do not have a matching rhumb line network,

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[51] Edson: (2004), pp. 7-8.

[52] Campbell: (1987), p. 406.

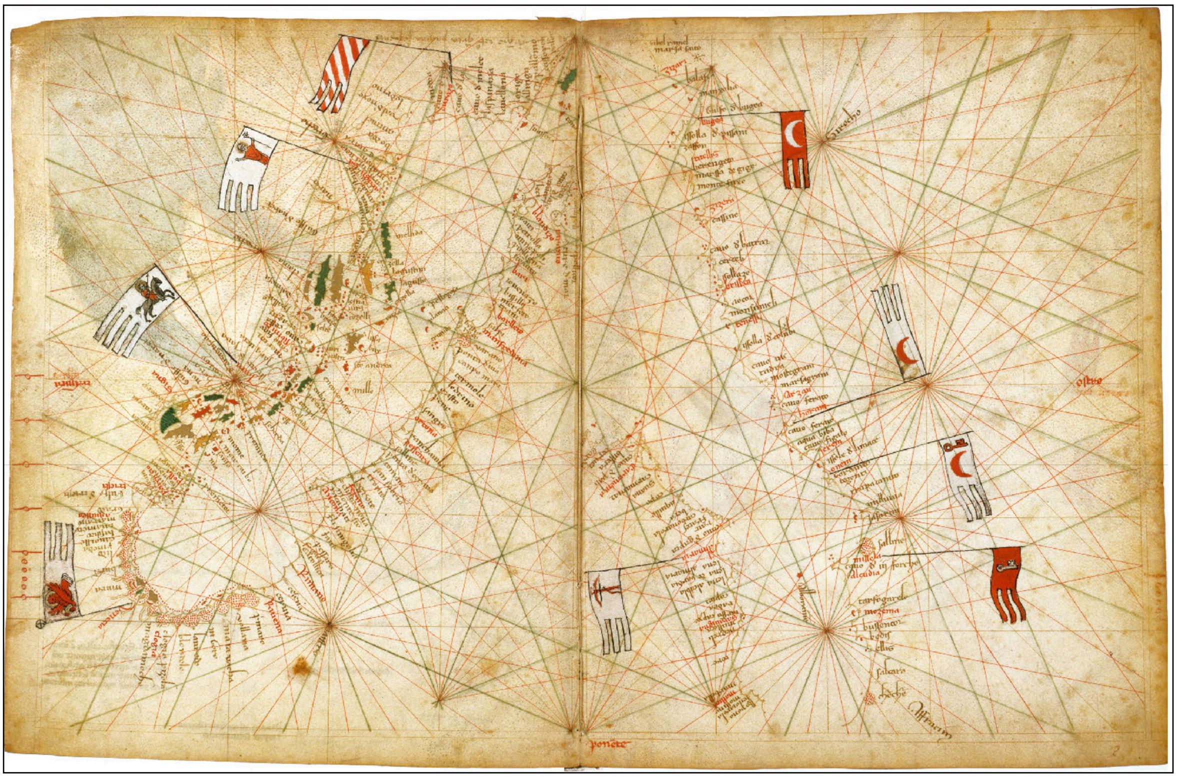

Figure 2.1.8: The central map (5v-6r) in the 1320 Vesconte Atlas in Rome: BAV, Pal. Lat. 1362a. 5v depicts the Adriatic Sea, and 6v southwestern Iberia and Africa. Image from: Pujades i Bataller (2007) DVD Supplement.

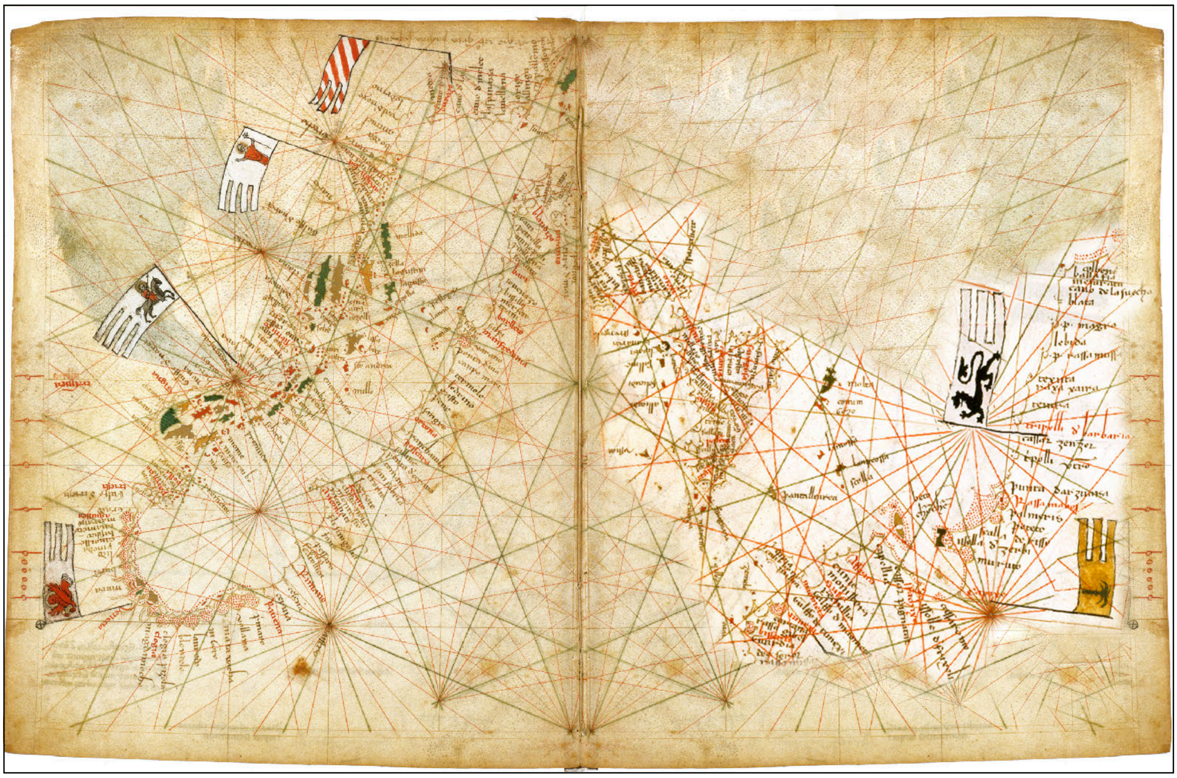

Figure 2.1.9: Folio 5v from the central map, with what 6r potentially looked like before the central parchment sheet was removed. Reconstruction is using a coastline taken from: Rome: BAV, Vat. Lat. 2962. Images from: Pujades i Bataller (2007) DVD Supplement.

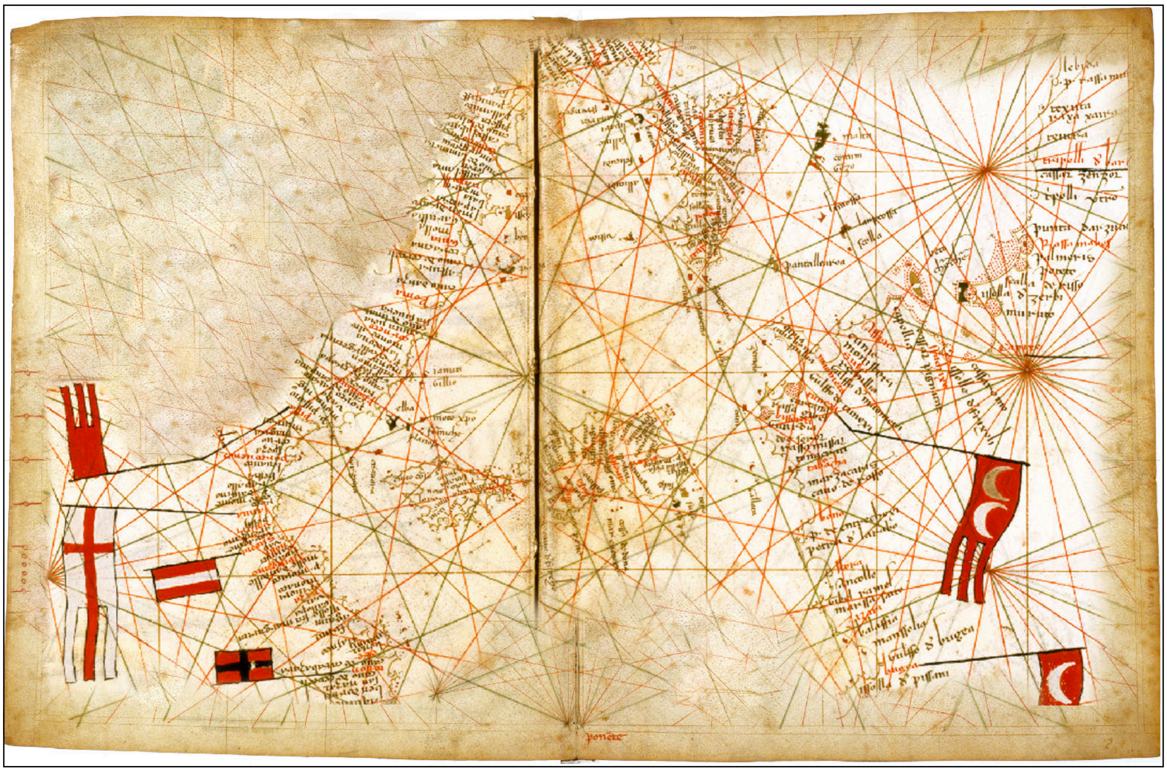

Figure 2.1.10: Theoretical folios 6v-7r from the central map, showing hydrography now completely missing from the 1320 atlas. Reconstruction coastline taken from: Rome: BAV, Vat. Lat. 2962. Images from: Pujades i Bataller (2007) DVD Supplement.

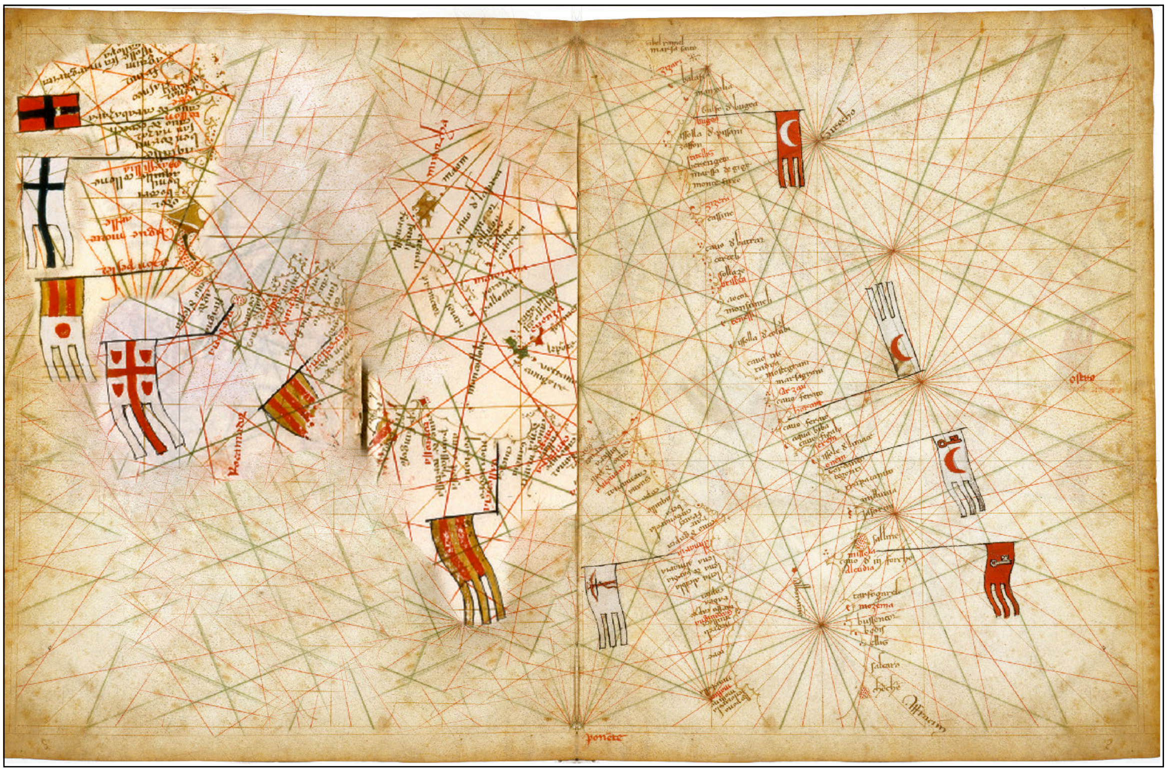

Figure 2.1.11: Folio 6r from the central map on the right, (which would have been 8r), with theoretical 7v on the left. Reconstruction uses a coastline taken from: Rome: BAV, Vat. Lat. 2962. Images from: Pujades i Bataller (2007) DVD Supplement.

which on the other maps was drawn across from one folio to another, after the quire was bound together.

It is possible to reconstruct the missing folios using the maps found in the other *Liber* atlas presented to the Pope. Figure 2.1.9 shows how 5v and what would have been 6r might have appeared before the central parchment was removed. Although it seems unusual that Vesconte did not choose to continue the Italian coastline beyond Calabria, back onto 5v, this section of coast is represented in the next map. Figure 2.1.10 depicts what would have been folios 6v and 7r, covering the western coast of Italy, Corsica, Sardinia, and Sicily. Because this map included both Rome and Avignon, and was the only map in the atlas drawn across a single piece of parchment, it is conceivable that its removal was to be displayed separately as a decorative map. Figure 2.1.11 shows what would have been 7v, and 6r which would have been 8r had the central parchment not been removed, which shows the coastline of Catalonia and the Balearic Islands. These reconstructions demonstrate that the entire Mediterranean would have been represented if there had once been a central sheet of parchment that is now missing.

Comparison of the hydrography of the Adriatic between this atlas and the other c. 1321 Vatican atlas[53] revealed a greater dissimilarity than expected, given the two maps were copied at around the same time. Figure 2.1.12 shows the two superimposed coastlines, and that of Vesconte's 1311 chart. Although they are more similar to each other than to the *Carte Pisane* and Cortona chart, there are interesting differences. Most notably, the scale of the c.1321 Vatican atlas is completely incorrect by thirteen percent, because the scale on each map of the atlas was the same as that depicted for the Black Sea.[54] It is intriguing that such a mistake would have occurred on the atlas destined to be a gift to the Pope. Perhaps it was a mistake, or perhaps it indicates that Vesconte was unsure about the scale of the Black Sea and Mediterranean. Second, the hydrography of the 1320 atlas and the 1311 chart appear to align more closely with each other than with the c.1321 atlas, which shows an absurdly-sized Kvarner bay (near the modern Croatian city of Rijeka) and Gulf of Naretva, and a much-too-far inland coastline between Manfredonia and Bari in Puglia.

[53] Rome: BAV: Vat. Lat. 2972.

[54] The scale of the Black Sea was consistently larger than that of the Mediterranean, as mentioned in Chapter I. Chapter IV discusses this in more detail, and the implications this scale inconsistency had on their function.

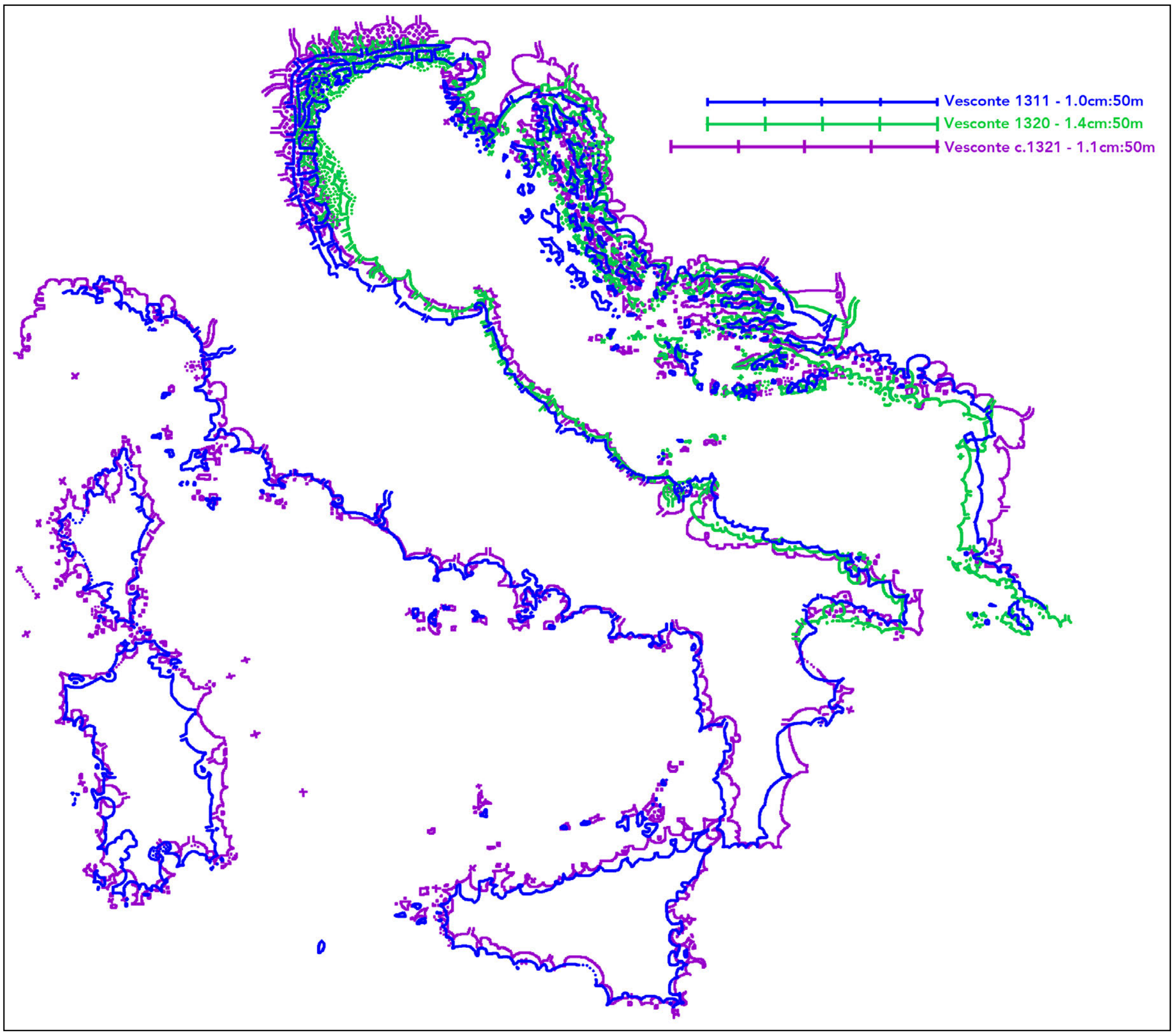

Figure 2.1.12: Three superimposed Petrus Vesconte coastlines, traced from the 1311 chart, 1320 atlas, and c.1321 atlas. Note how much larger the scale on the c.1321 atlas is, when the hydrography was aligned. Digital tracings were made from images in: Pujades i Bataller (2007) DVD Supplement.

The differences between the 1320 atlas and the c.1321 atlas indicate that they were not copied from the same exemplar. Both were drawn at different scales, (1.4cm and 1.1cm per 50 *miglia* respectively), but had they been copied from the same map, even by the square grid technique, they would have been more similar. This indicates Vesconte had exemplars at different scales, which were dissimilar from each other. As was established in Chapter I, there would have been no reason to have more accurate and less accurate maps from which to copy utilitarian and aesthetic charts respectively. Given the hydrographic differences, of which the major ones would have surely been visible to Vesconte, the fact that there are differences indicates that accuracy in the actual shape of the coastline was not all that important to the maps' function.

Vexillography

One of the most distinctive aspects of Vesconte's *Liber* portolan maps is the inclusion of rather large flags. In all, twenty-seven flags are found in the 1320 atlas.[55] No surviving portolan map prior to this 1320 atlas included vexillography, and flags were certainly not common on *mappaemundi* or other maps.[56] These inclusions also appear in the 1321 atlas by Petrus Vesconte, and the c. 1325 atlas from his atelier. However, no flags were found in any of Petrus' other maps, nor in Perinus' 1321 atlas, but Perinus' only surviving chart of 1327 did include them.

Tony Campbell discussed the vexillology of portolan charts, and he noted their inclusion on roughly forty percent of fourteenth- and fifteenth-century portolan maps.[57] Thus, they were an integral, or at least popular, component of many charts. Campbell warned however, against the automatic assumption of their accuracy, and wrote that "many a Christian sailor would have ended up a galley slave had he relied on his chart to distinguish friend from foe."[58] At the time, flags were not standardised, heraldic emblems and colours were regularly altered, and generalisations were common. Astengo concluded that in the sixteenth and seventeenth centuries, flags, though more prevalent, "became much more vague and repetitive … thus limiting themselves to giving religious and cultural – but certainly not political – information."[59] Campbell demonstrated that flags were used to show a selective truth about the shifting geopolitical scene: victories, such as the conquest of Ceuta by John I of Portugal in 1415, were often quickly recognised by a changing flag on the maps, whereas defeats – especially against Muslims – were often denied for decades, sometimes by the conscious inclusion of a former flag.[60] Campbell concluded that rather than historical events, ownership, and sovereignty, flags instead relayed psychological attitudes.[61]

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[55] If the reconstructed coastlines of the missing sheet depicted the same flags as the c.1321 atlas, a further sixteen would be apparent.

[56] An exhaustive search of images of many maps prior to the 1320 Vesconte atlas revealed no map including flags, even if they were highly decorated, such as the Hereford *mappamundi*.

[57] Campbell: (1987), pp. 399-401.

[58] Ibid. p. 401.

[59] Astengo: (2007), p. 202.

[60] This particular use of vexillography was epitomised by Albinus de Canepa on this 1489 chart, as discussed in the case study below.

[61] Campbell: (1987), pp. 400-401.

A comparison of the flags from Vesconte's maps indicates little variation of the cities that displayed them, their colour, or their design. This indicates that the maps being made to accompany the *Liber* were being copied from an exemplar, including the flags. As discussed in Chapter I, many maps were likely copied as identically as possible from the originals, because it was quicker and less expensive. Their similarity suggests that the original selection of flags occurred at the beginning of the endeavour, making it possible that it was Sanudo who chose the flags.

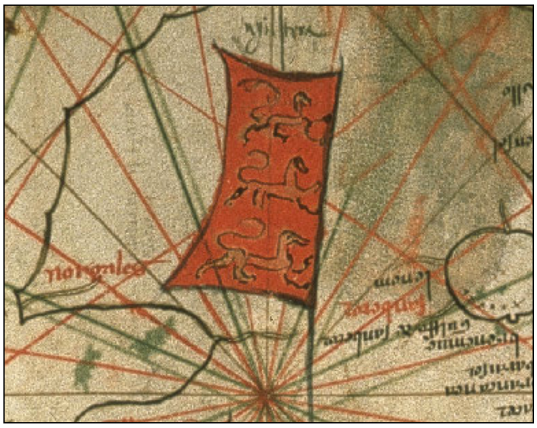

Figure 2.1.13: Flag depicted over the British Isles on the c.1325 atlas, likely by Perinus Vesconte: London: BL, Add. MS. 27376, f. 2r. Image from: Pujades i Bataller (2007) DVD Supplement.

Provided the missing coastlines of the 1320 atlas (from the theoretical missing map) depicted the same flags as seen on the others, then there was only one unique flag, which was depicted on the c.1325 atlas over Britain: gules, three lions passant Or.[62] This focus on the British Isles possibly indicates it was made for an English recipient, but is not known for whom the atlas was made; Degenhart and Schmitt noted that the atlas was in the library of Abbot Luigi Canonici in the late eighteenth century in Venice.[63] Although the atlas was unsigned, it is thought to have been made by Perinus Vesconte circa 1325, rather than by Petrus. While the scribal hand appears to be that of Perinus, the flags were certainly not up to his usual standard. Compared with the masterful illumination in other works, the flags of the London atlas were rather poorly drawn. They seem to have been either hastily executed by an apprentice artist in the atelier, or were drawn later at the owner's behest.

Given that flags do not appear in Petrus Vesconte's other cartography, the impetus for their inclusion was surely related to the *Liber secretorum*, and it would be safe to assume that Petrus Vesconte was not the instigator behind their addition (otherwise why would flags not have appeared in his other works?). More likely it was Sanudo himself who requested the inclusion of flags on the maps: certainly, they were not an afterthought, appearing on both atlases that were presented to Pope John XXII. Sanudo's goal was to motivate the courts of

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[62] London: BL, Add. MS. 27376.

[63] Degenhart, Bernhard et al.: 'Marino Sanudo und Paolino Veneto: zwei Literaten des 14. Jahrhunderts in ihrer Wirkung auf Buchillustrierung ung Kartographie in Venedig, Avignon und Neapel', *Römisches Jahrbuch für Kunstgeschichte*, 14 (1973), 1-137. p. 24.

Europe to begin another crusade, to go to war against the infidel. The inclusion of maps and their content was carefully designed toward this purpose, probably with the intention that they would not only inspire and motivate, but also make his campaign more memorable and worthy of thought and discussion.

The vexillography of Vesconte nevertheless proved incredibly popular, and a significant percentage of later portolan maps included flags, even if they were otherwise undecorated. The 1431 chart by Venetian Francesco Cesanis included no other decoration but thirty large and well-painted flags, and appears incredibly reminiscent of the *Liber secretorum* portolans. Angelino Dulceti included flags in his extant maps, and through him flags became a standard inclusion for all Majorcan charts. If there was a single original aspect that Vesconte brought to the genre of portolan cartography, it was vexillography.

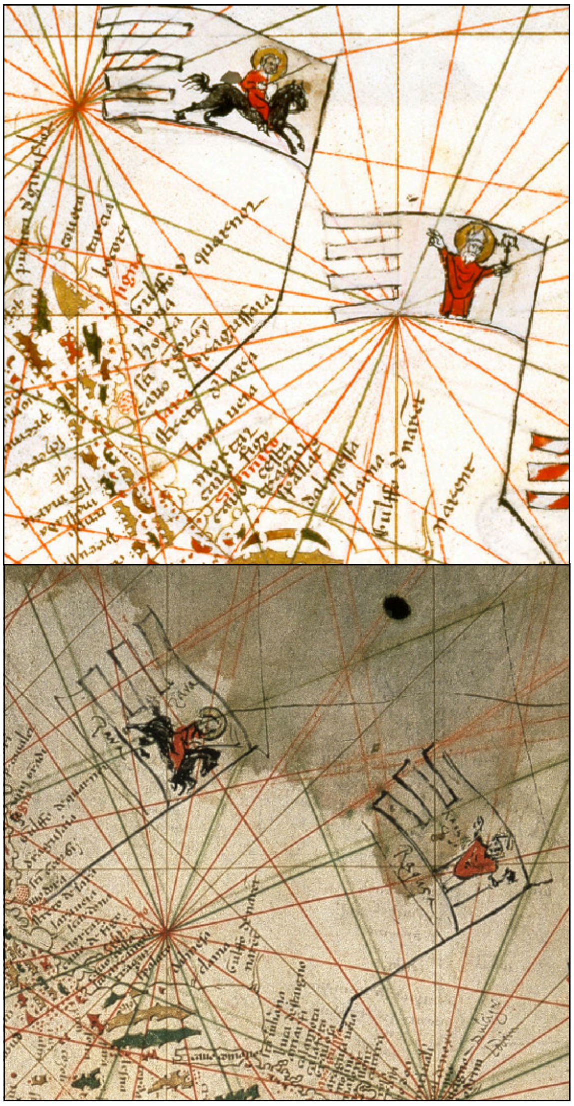

Figure 2.1.14: Flags compared between Petrus Vesconte's c.1321 atlas in Rome: BAV, Vat. Lat. 2962, f. 4v (above) and Perinus' c.1325 atlas in London: BL, Add. MS. 27376 (below). Images from: Pujades i Bataller (2007) DVD Supplement.

Conclusion

Although portolan maps appear in only three of the thirteen surviving atlases of the *Liber secretorum*, they must have nonetheless been an important component. The cost of producing a portolan chart, let alone several pages of an atlas was significant, as both Chapters I and III indicate. Additionally, the fact that Sanudo (most likely) requested the insertion of flags indicates that he had better reason for including portolan maps than simply to bulk out the atlas component. The evidence demonstrates that portolan maps were included for several reasons. First, as Sanudo indicated in his 1332 letter to King Philip VI of France, they were intended to aide the specific directions laid out in the *Liber* for the preparation and undertaking of the new crusade. Second, the inclusion of flags may have incited a feeling of patriotism, fuelling the desire to go to war. Third, by including not only a couple of simple maps (as a few other crusade proposals at the time did) but a large number of highly detailed maps, Sanudo ensured that it was his proposal to which the most attention and consideration would be paid; not only did the Christian world stand to gain spiritually from retaking the Holy Land, but Venice itself would have likely gained economically had Sanudo's plan come to fruition, from which he would have benefitted.

Little is known about Petrus Vesconte (or Perinus), except what can be gleaned from extant maps. The charts in the *Liber secretorum* were significantly different to the standard atlases, so it is reasonable to assume someone other than Vesconte (probably Sanudo) had influence over their original design. However, the palaeographic and codicological evidence suggests that all the maps, even if not by Vesconte himself, were made in the same workshop, and because Petrus' signature is the only one that appears, it can be concluded that he oversaw their overall creation.

Petrus Vesconte was additionally an innovator: his maps depicted improved hydrography, especially of the British Isles as Campbell has shown.[64] He was the first to include significant decoration, and the first to make luxury atlases that were clearly for wealthy customers, not for navigation. Not only did Petrus introduce new content and styles, but these were adopted by other later chart-makers, including the new standard scale bar, the inclusion of flags, and the exaggerated coastline. Furthermore, Vesconte was possibly the first to popularise the portolan map, which undoubtedly was aided by Marino Sanudo's dissemination of the *Liber secretorum*. It is possible that this book revealed these maps to many patrons that had never seen their like before, and through Sanudo and Vesconte, the portolan map, as a genre, changed from a largely unknown specialist item to a desirable commodity for the wealthy and learned.

[64] Campbell: (1987), pp. 407-408.

The 1339 Chart of Angelino Dulceti

The Father of the Majorcan School

With the exception of Giovanni da Carignano, a clergyman who was not likely a full-time chart-maker,[65] the next earliest professional cartographer after the Vesconti was Angelino Dulceti, who is considered to have been the founder of the 'Majorcan School'. Only two extant charts were signed by him: the first, in the private collection of Prince Filippo Corsini, is dated March 1330; the second, in the Bibliothèque Nationale, is the chart dated 1339.[66] An additional unsigned chart in the British Library can possibly be attributed to him because of its similar style and content.[67] A fourth chart in Venice has been attributed to him, though Falchetta posited it was not by Dulceti, though probably a missing link between him and the Catalan Atlas.[68]

Whereas Petrus and Perinus Vesconte decorated their atlases with beautifully-illuminated corner portraits of holy figures, and on the maps of Marino Sanudo's *Liber secretorum* included flags, Dulceti took the extent of adornment much further, incorporating many elements previously only included on sumptuous *mappaemundi*. The 1339 chart, which will be examined in this case study, included, in addition to numerous flags, geographical features such as mountains, rivers, cities, depictions of kings, and historical, geographical, and anthropological expository texts. It is through this chart that Angelino Dulceti has often been considered the father of the 'Majorcan School' of portolan cartography, which lasted through the fifteenth century, before it declined in the sixteenth.[69] Many motifs first depicted on the 1339 chart were copied and recopied for over a century, as on the luxurious c.1375 Catalan Atlas, made by Cresques Abraham and presented to King Charles VI of France in 1381 by Peter IV of Aragon.[70] Analysis of the 1339 chart, its

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65 A single chart from Giovanni da Carignano survived until it was destroyed in 1943, which is discussed in greater detail below.

66 Paris: BN, Rés. Ge. B 696.

67 London: BL, Add. MS. 25691.

68 Venice: Biblioteca Marciana, Ms. It. IV, 1912 (=10057). See: Falchetta, Piero: 'Manuscript No. 10057 in the Biblioteca Marciana, Venice: A Possible Source for the Catalan Atlas?', *Imago Mundi*, 46 (1994), 19-28esp. p. 19 (note 2).

69 See: Winter, Heinrich: 'Catalan Portolan Maps and Their Place in the Total View of Cartographic Development', *Imago Mundi*, 11 (1954), 1-12. pp. 6-7; Bagrow, Leo: *History of Cartography*, trans. by D. L. Paisley, ed. by R. A. Skelton, 2nd edn. (London: C. A. Watts, 1964; repr. Chicago: Precedent, 1985). pp. 65-66; Campbell: (1987), p. 393; Pujades i Bataller: (2007), pp. 482, 490-491.

70 Bagrow: (1985), p. 66.

precedents and legacy, will establish that its function, and the function of all similar portolan maps, was didactic and aesthetic, rather than for navigation.

Corpus of Surviving Work

Until recently, there was debate concerning the name and date that appears on Dulceti's 1330 and 1339 maps. Although the earliest scholarly article on the chart listed the date of the 1330 chart as 'MCCCXXX', and the name as 'Angellinus de Dulceto', Alberto Magnaghi, spurred by nationalist intentions, published many articles purporting the chart to date to 1325 (mistaking the final 'X' for 'V'), and the name as 'de Dalorto', which, unlike 'Dulceto', was firmly a Genoese name. Because the chart was in private hands, and thus difficult to view, this misinformation, whether intentional or not, was continually republished. The repercussions were debates over whether Dulceti (author of the 1339 map) and 'de Dalorto' were the same chart-maker. However, Pujades i Bataller was able to view the map, and reestablish that the date is 1330, and that 'de Dulceto' is the correct reading of the signature.[71] Thus, 'Angelino Dulceti' in the genitive, and 'Angellinus de Dulceto' in the ablative, were merely two ways of writing the same name.

Concerning the anonymous London chart in the British Library, Heinrich Winter and Giuseppe Caraci believed that it dated prior to 1324 because Sardinia did not feature the arms of Aragon, which were drawn on the other two maps.[72] However, as Campbell discussed, the use of vexillology to date undated maps is fraught with limitations, and in this case does not preclude the map from a later date. Campbell demonstrated through his toponymic analysis that the chart was more likely made after the 1339 chart, because it contained all of the toponyms found on the 1339 chart.[73] Few scholars have doubted that the chart was made by Dulceti, or at least someone in his atelier. As figures 2.2.1 and 2.2.2 demonstrate, the script, the drawing of the flags, Saint Peter's Basilica and depiction of the city of Venice are stylistically similar.

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[71] Pujades i Bataller: (2007), p. 491.

[72] Campbell: (1987), p. 424 (note 361).

[73] Ibid. The lack of Aragonese arms on Sardinia means nothing in terms of dating: the chart-maker may have simply forgotten to draw them, or chose not to include them. For Campbell's discussion on the limits of vexillological dating, see: Ibid. p. 399 .

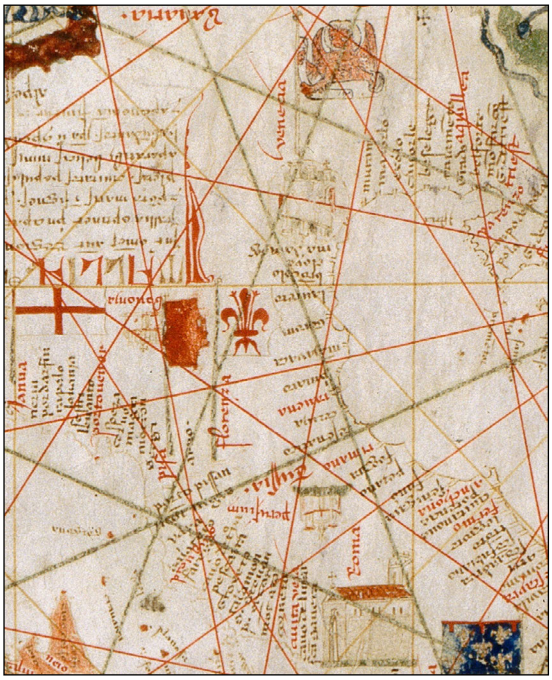

Figure 2.2.1: Northern Italy depicted on the 1339 Angelino Dulceti map in Paris: BNF, Rés. Ge. B696. Image courtesy of the Bibliothèque Nationale de France.

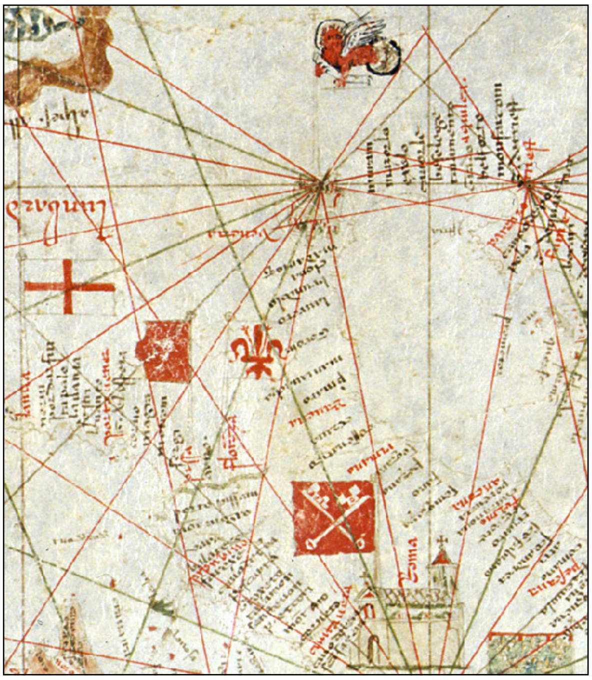

Figure 2.2.2: Northern Italy depicted on the anonymous Majorcan chart in London: BL, Add. MS. 25691. Image from: Pujades i Bataller (2007) DVD Supplement.

Although Pujades and Campbell have demonstrated that all three charts were produced by the same maker, Angelino's nationality remains ambiguous. Some scholars have argued that he was Genoese, and that his name was a variation of 'Dulcedo', a small Genoese commune east-northeast of San Remo, and others that he was Majorcan and his surname a variation of the Catalan name 'Dolcet'. Pujades noted that archival work by Llompart i Moragues revealed an 'Angellino Dulcieti' living in an area of Palma de Majorca where Genoese merchants naturalised as citizens of the kingdom in 1344/45.[74] Furthermore, the signature on the 1339 chart stated that it was made "in ciuitate maiorcharum". Certainly, Angelino was in Majorca by 1339, and the 1330 chart was potentially made there as well. Pujades additionally noted that the toponymic pattern of both Dulceti's charts was throughly Genoese.[75] However, there are no earlier Majorcan examples with which it may be compared: the next earliest known Majorcan chart-makers – Cresques Abraham and Guillem Soler – copied Dulceti. Although the evidence suggests Dulceti was Genoese, his nationality will probably never be agreed upon. Regardless of nationality, Dulceti influenced the cartography in Majorca for the rest of the century and beyond.

[74] Pujades i Bataller: (2007), p. 490 (note 77).

[75] Ibid. p. 491

Cartographic Precedents

Angelino Dulceti may not have been the first to draw a portolan chart heavily embellished with ornamentation and eclectic information, depending on the date of Giovanni da Carignano's portolan chart. Unfortunately, the relationship between Giovanni da Carignano and Angelino Dulceti is unknown, both chronologically and influentially. Nordenskiöld listed two maps by Carignano: the first, located at the state archive in Florence, was destroyed by incendiary bombing in 1943; the second was said to be dated 1306, but with unknown whereabouts, and it has never emerged since its original cataloguing by Uzielli and Amat in 1882.[76] There are a few reproductions of the Florence

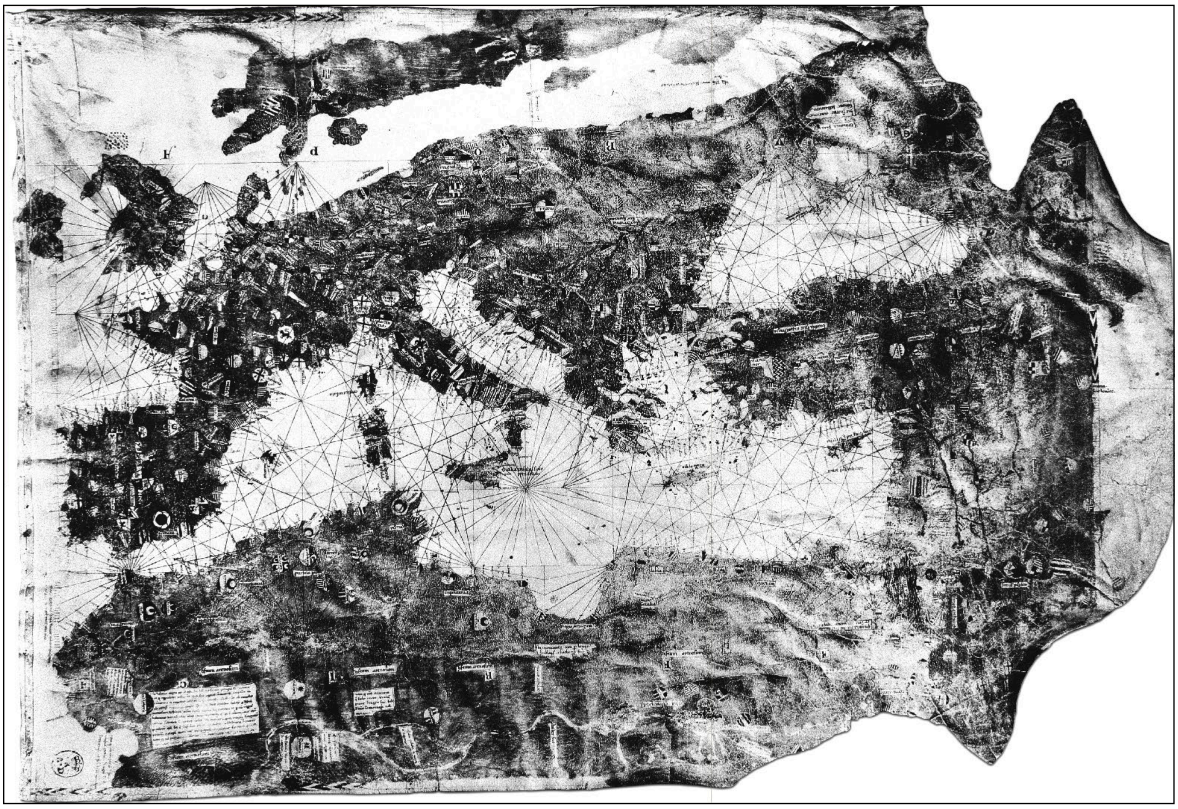

Figure 2.2.3: Photostat of the Giovanni da Carignano map, which was destroyed in WWII: Florence: AS, CN2. Image from: Pujades i Bataller (2007) DVD Supplement.

map, which are all monochrome and of only marginal quality. The signature – "Johannes presbyter, rector sancti Marci de portu Janue me fecit" – reveals that Carignano was a rector of the parish of St Mark in Genoa. The map is undated, but documents have

[76] Nordenskiöld: (1964), p. 56.

revealed that he died sometime between September 1329 and May 1330.[77] Campbell concluded from hydrographic evidence that the map must have been drawn close to the end of Carignano's life, and that it was unlikely he was a full-time cartographer, with which Pujades agreed.[78] Although only a poor monochromatic photostat, one sees that the island of Sardinia depicts the arms of Aragon, which, unlike its use to date the anonymous London chart discussed above, demonstrates a terminus post quem by which it probably dates after 1324 when an alliance between Aragon and the Giudicato of Arborea occupied most of the island.[79] Thus, Pujades' estimated date of c.1327 is fair.

The Carignano chart, like the charts of Angelino Dulceti, is heavily decorated, and included tracts of textual explanations. It was not designed for use at sea, not because of its adornment, but because Giovanni painted the land of the map and wrote the toponyms (of which there were few) into the sea, obscuring the littoral. It is the only portolan chart that sacrificed its coastline to its aesthetic; even the Catalan Atlas included a standard number of toponyms and wrote inland. The Carignano map was thus a hybrid of a *mappaemundi* and standard portolan chart, melding various eclectic elements. The inclusion of texts, ornamentation, and internal features was also adopted by Dulceti, but it was he who influenced the style of the 'Majorcan School' for over a century.

Figure 2.2.4: Sardinia depicted on the Giovanni da Carignano map, of which only a photostat image survives: Florence: AS, CN2. Image from: Pujades i Bataller (2007) DVD Supplement.

[77] Ferretto, Arturo: 'Giovanni Mauro de Carignano Rettore de S. Marco, cartografo e scrittore (1291-1329)', *Atti della Società Ligure di Storia Patria*, 52 (1924), 33-52. As cited in: Campbell: (1987), p. 404 (note 258).

[78] Ibid. pp. 404-406 ; Pujades i Bataller: (2007), pp. 490, 517.

[79] Campbell noted however, that much of Sardinia was largely Aragonese since 1297, so this terminus post quem is only indicative, not certain. See: Campbell: (1987), p. 399. Interestingly, on the Giudicato of Logudoro on Sicily, the Genoese cross of St George was also depicted, perhaps out of a sense of patriotism to show that the Aragonese had not taken the whole of the island.

Hydrographic comparison of the coastlines around Italy shows a moderate similarity between Petrus Vesconte's littoral as copied from both his 1320 and c.1321 atlases and that of Giovanni da Carignano's chart, enough to suggest that Carignano might have copied Vesconte, perhaps one that had been circulated in the *Liber secretorum*. Particularly similar is

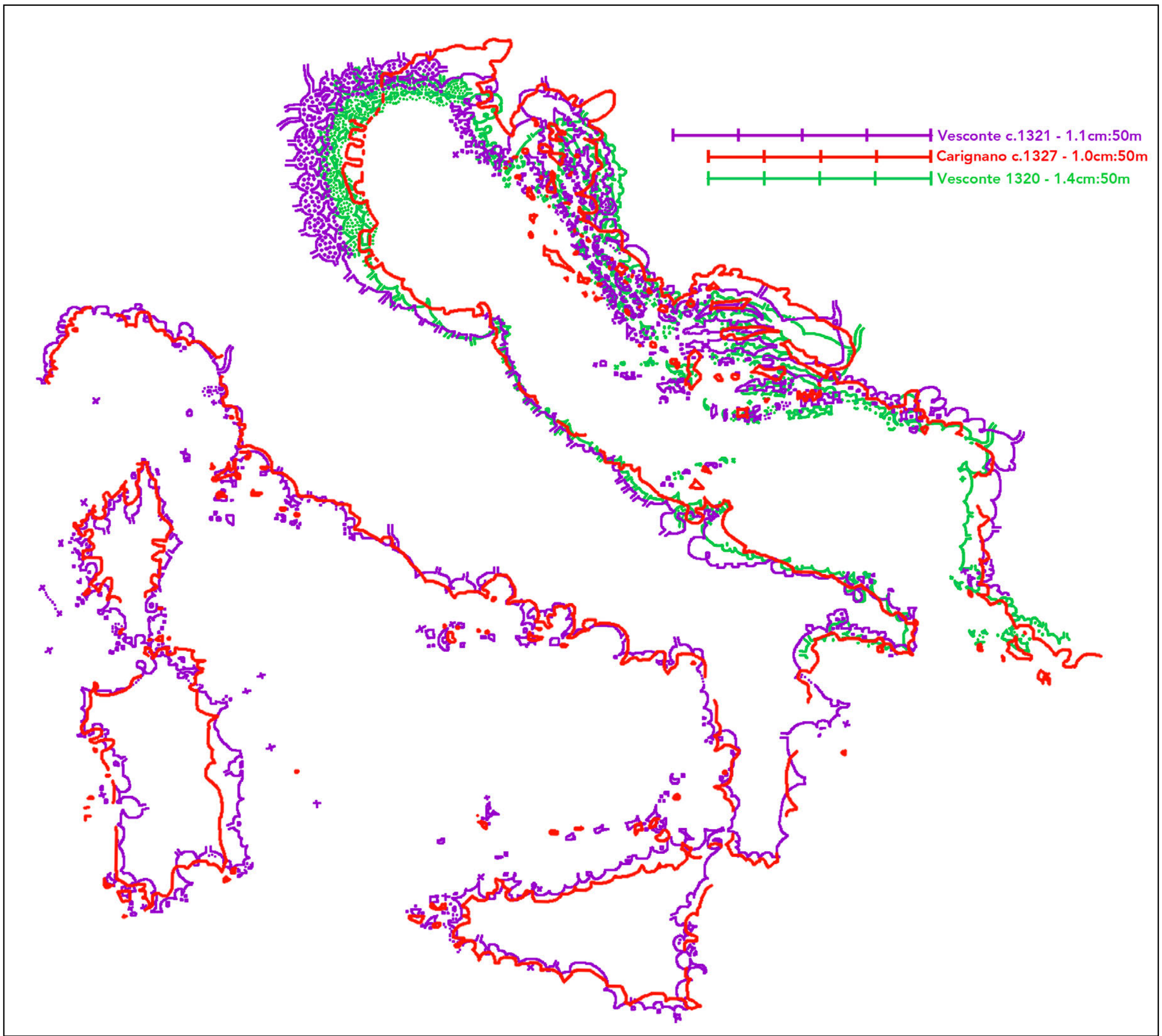

Figure 2.2.5: Superimposition of the Italian coastlines between Petrus Vesconte's 1320 and c. 1321 atlases and the Giovanni da Carignano chart. Digital tracings made from images from: Pujades i Bataller (2007) DVD Supplement.

the western Italian coastline. Although the Adriatic does not appear as alike as the rest, it is possible Carignano compiled his chart from different atlas pages, using a separate map of each sea.

The hydrography of Dulceti's 1339 chart appears less similar to Vesconte's than Carignano's did, but is certainly closer to Vesconte's than to either the *Carte Pisane* or Cortona Chart. Additionally, Dulceti adopted the same hydrographic style of exaggerated promontories and geometric bays. Thus it is possible he too used a Vesconte model, or at least an intermediary. However, Dulceti shortened the length of the Adriatic (although by a little too much) indicating either he, or his unknown exemplar, recognised the earlier mistake. Carignano had not known about the exaggerated length of the Adriatic, suggesting it is unlikely he copied from Dulceti. Had Carignano's map not been destroyed and were the toponymy legible in reproductions, perhaps this question could have been answered with a more thorough analysis, but for now, it remains a mystery.

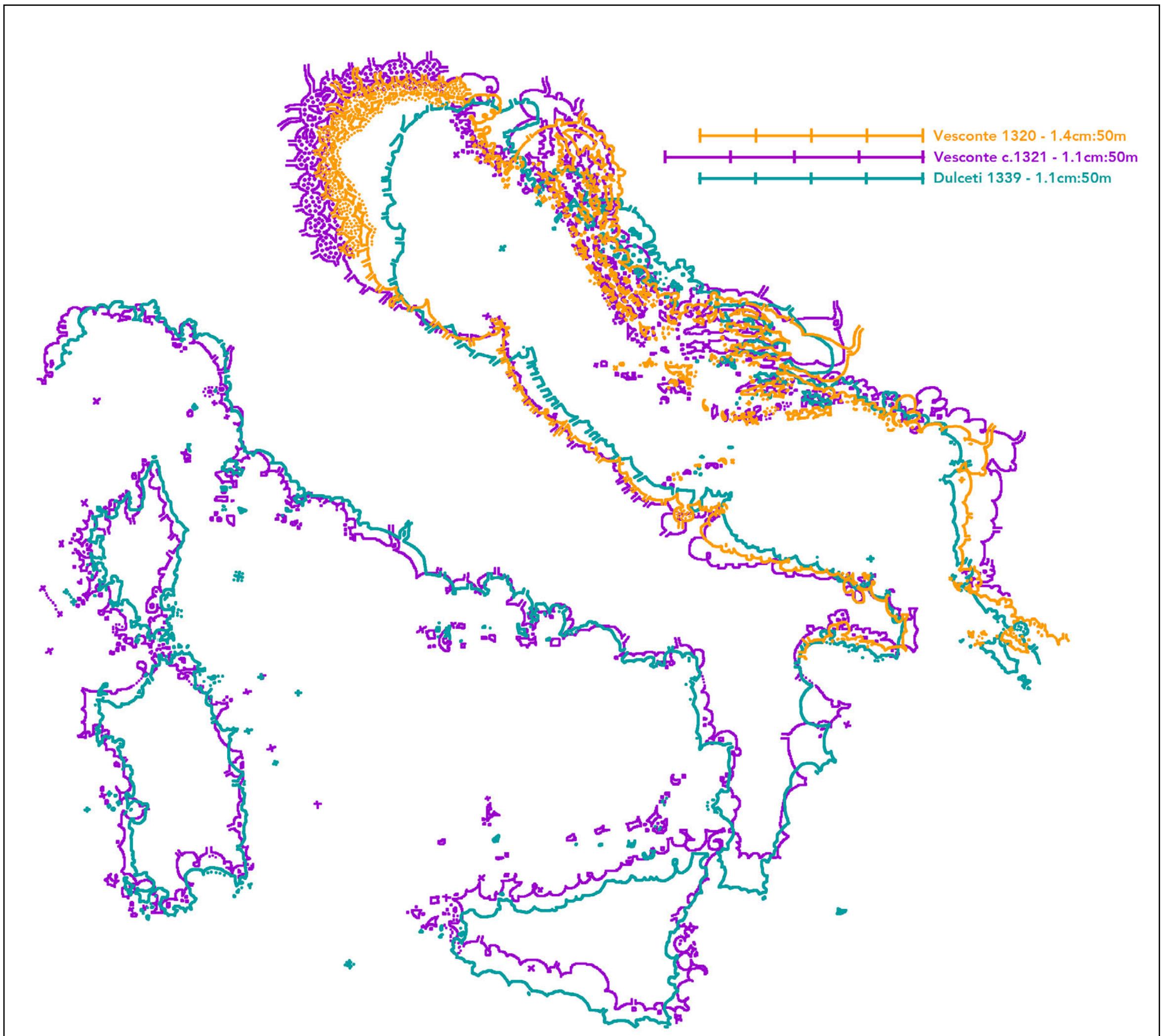

Figure 2.2.6: Superimposition of the Italian coastlines between Petrus Vesconte's 1320 and c. 1321 atlases and Dulceti's 1339 chart. Digital tracings made from images from: Pujades i Bataller (2007) DVD Supplement, and a facsimile courtesy of the Bibliothèque Nationale.

The Chart of 1339

Even if Angelino Dulceti drew inspiration from Carignano, his contribution to the genre of portolan cartography is considerable. Dulceti improved on both the hydrography and toponymy in comparison with earlier charts, in addition to creating an aesthetic and didactic style that was adopted by many subsequent cartographers. Considered exceptionally important in the early development of the genre of portolan cartography, the following section will examine his chart of 1339 in greater detail, with particular reference

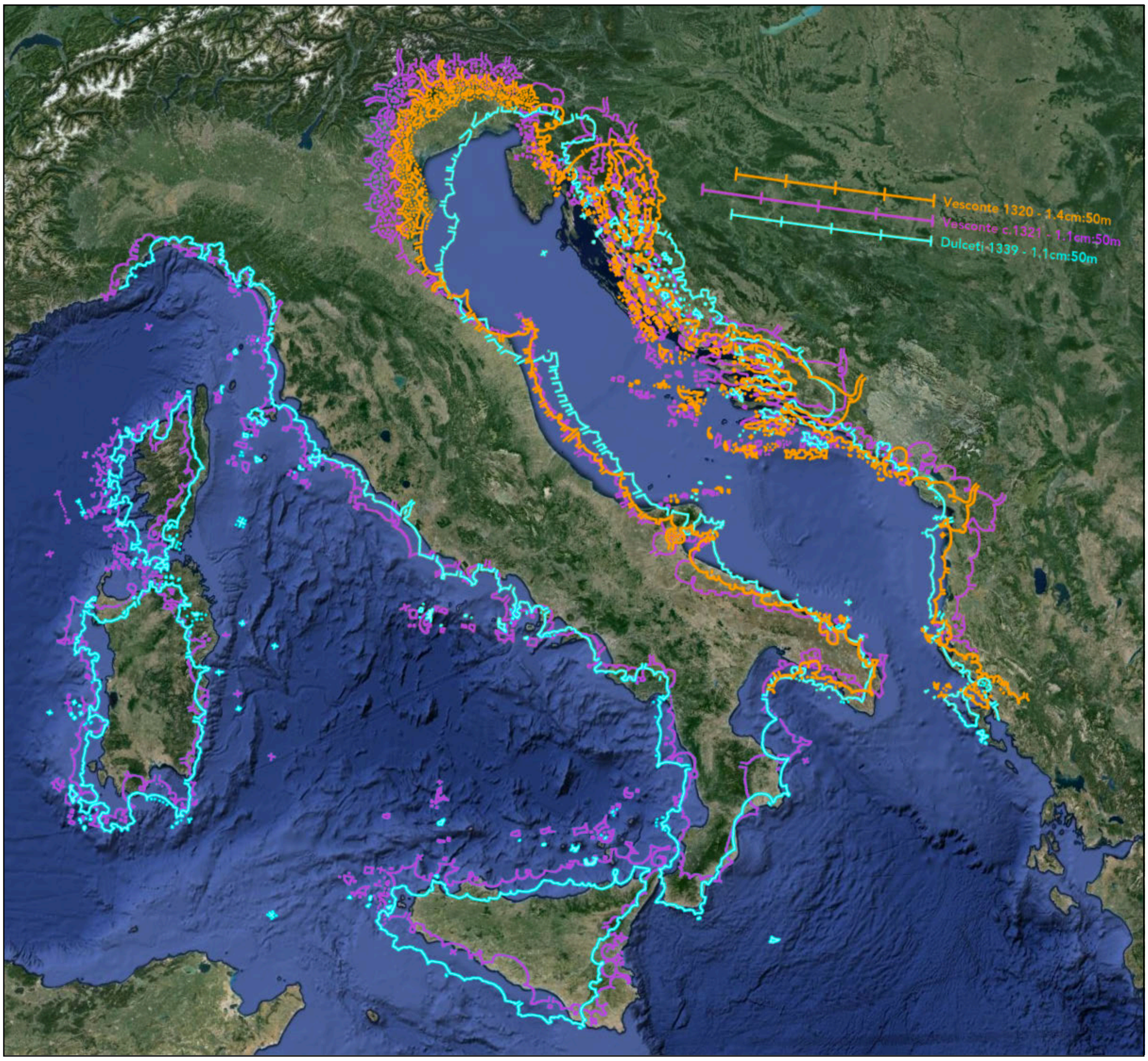

Figure 2.2.7: Superimposition of the Italian coastlines of Petrus Vesconte's 1320 and c.1321 atlases and Dulceti's 1339 chart above satellite imagery of Italy. Note that while both coastlines exhibit exaggeration of the littoral, the overall dimensions are more correct on Dulceti's chart. Digital tracings made from images from: Pujades i Bataller (2007) DVD Supplement, and a facsimile courtesy of the Bibliothèque Nationale. Satellite imagery from Google Earth.

to the extent of its imitation in later maps. It is hoped this will demonstrate that the aesthetic and didactic style of the 'Majorcan School' was ingrained into their cartography, bringing into question the extent to which they would have additionally created undecorated utilitarian maps for navigation.

Figure 2.2.8: The 1339 Angelino Dulceti map in Paris: BNF, Rés. Ge. B696. Image courtesy of the Bibliothèque Nationale de France.

The chart measures 75 cm by 102 cm, consisting of two pieces of parchment pasted together. It was trimmed back on all four edges at some point in the past by an unknown amount. A few scholars, including Armando Cortesão, have argued that the chart once had a considerably larger eastern section, and included the same geography as the Catalan

Atlas.[80] However, Cesáreo Fernández Duro questioned that the map would include as much of Asia as the Catalan Atlas, since the writings of Marco Polo had not been disseminated to Majorca by 1339.[81] The position of the signature in the far northeast edge of the map indicates that probably not more than ten centimetres had been trimmed off the eastern side, otherwise the signature would have been unusually in the middle of the map oriented eastward. Covered in a double-rhumb line network, the hydrography included the entire Mediterranean, Black Sea, Africa slightly past Cape Bojador, the Baltic, southern Scandinavia, and also includes a considerable amount of the Middle East, including the Persian Gulf.

Signature and Script

The mediocre state of preservation has caused the signature to be moderately obscured. It reads: "Hoc opus fecit angelino dulc[e]ti ano mº cºcºcº xxxviiij de mense aug[us]ti in ciuitate maioricharum". Unlike Dulceti's 1330 chart, on which the signature was written at the neck of the map in the Atlantic, the signature here is located in the far northeast corner, aligned to the east, and appears directly underneath an illustration of the monarch Ozbeg Khan. The signature almost appears like an unplanned afterthought, especially when it could have been written in the ample empty areas of the Atlantic, but the script does appear to be Dulceti's, and is congruous with the map, rather than added later.

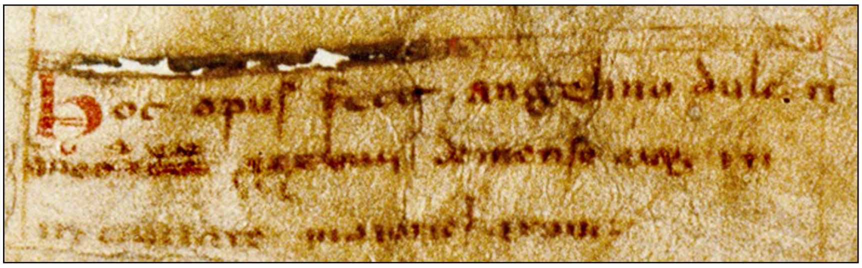

Figure 2.2.9: The signature on the 1339 Angelino Dulceti map (Paris: BNF, Rés. Ge. B696.) Image courtesy of the Bibliothèque Nationale de France.

The script used by Dulceti is a clear littera gothica textualis media, of the sort commonly associated with professional notaries rather than university-educated scribes. Regional names in capitals, such as '*Italia*' and '*Anglietera*' were written in alternating red and black gothic capitals. Pujades noted that his Latin, while incorrect in places, used

[80] Ibid. p. 394 (note 209).

[81] Fernández Duro, Cesário: 'Descubrimiento de una carta de marear, española, del año 1339. Su autor Angelino Dulceri ó Dulcert', *Boletín de la Real Academia de la Historia*, 12 (1888), 287-314. p. 302.

complex grammatical structures, indicating he was a well-trained professional, though probably not university educated.[82] Winter, noted that despite quoting numerous Latin texts, the language was imperfect and subject to many "unconscious lapses" into Catalan linguistic forms.[83] Although Winter's evidence is questionable, Dulceti, though literate, did not have a perfect grasp of Latin.

Toponymy

Angelino Dulceti significantly improved the toponymy on his two charts. Campbell noted that the 1330 chart included seventy-nine new toponyms never written on any earlier map, and the chart of 1339 contributed a further twenty.[84] These place-names were not limited to the Catalan sphere of trade and travel at the time, but could be found across the Mediterranean, Black Sea and Atlantic coastlines. Noteworthy examples included: Belforte, a Venetian port built in 1274, which was never written in the Vesconte maps;[85] Monfalcone, a fortified town under the control of the Patriarch of Aquileia until conquered by Venice in 1420; Bilbao, and its port Portugalete; Almada, on the south side of the Tagus from Lisbon; Ostia, the port of Rome; and Avignon.[86] Additionally, Oldham noted that Dulceti was the first to write the 'a' of Aigue Mortes on the island and continue the name inland across the channel, to indicate its correct location.[87]

Heinrich Winter discussed the 'Catalanisation' of place-names by Dulceti, and provided several examples of this, such as the spelling of Tagus ('*toio*' by Dulceti versus '*tago*' in Italian charts), or of Porto Venere ('*portovener*' by Dulceti versus '*portovenere*').[88] Winter's motives however, were largely to portray Dulceti as Catalan rather than Italian, in what modern scholars such as Campbell have deemed a classic case of biased nationalism.[89] While Dulceti did use some Catalan word-forms, few were spelled differently

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[82] Pujades i Bataller: (2007), p. 490.

[83] Winter: (1954), p. 7.

[84] Campbell: (1987), p. 416.

[85] Ibid. p. 426.

[86] Campbell, Tony: 'Table of 'Significant Names", (2013) <http://www.maphistory.info/SigNamesFullTable.doc> [accessed 2 October 2013].

[87] Oldham, R. D.: 'The Portolan Maps of the Rhône Delta: A Contribution the History of the Sea Charts of the Middle Ages', *The Geographical Journal*, 65: 5 (1925), 403-424. p. 408.

[88] Winter: (1954), pp. 7-8.

[89] Campbell: (1987), pp. 392, 395.

from earlier charts: Porto Venere was also labelled '*portovener*' by Vesconte. Rosselló i Verger discussed toponymic word-forms, and noted that Catalan maps had a tendency to drop consonants from the middle of words, switch 'a's, 'e's and any unstressed vowel sounds, and drop vowel endings.[90] While this is certainly noticeable in the toponymy of later Majorcan portolan charts, such as Cresques' Catalan Atlas, it is not so much amongst the place-names of Dulceti. The table below lists the toponyms between Tarragona and Guardamar del Segura from Vesconte's 1320 atlas, Dulceti's 1339 chart, and from the Catalan Atlas. The spelling similarity between Vesconte and Dulceti is greater than between Dulceti and Abraham. Pujades concluded that Dulceti's toponymy was undoubtedly Genoese.[91]

Vesconte (1320)	***Dulceti (1339)***	***Catalan Atlas (c.1375)***
teragona	teragona	teragona
sallo	salo	sallou
rodelast(r)o	rod(o)iaster	riuduyastr(e)
ballag(e)r	balager	balager
s(an)c(t)i georGy		
	an pola	anpola
p(orto) fangosso	p(orto) fangoso	port fangos
tortossa	tortossa	tortossa
cauo de tortossa	grado de tortossa	grao de tortossa
paniscolla	peniscula	peniscula
	mo(n)colubre	mo(n)colubre
	coruo	corp
auro pessa	aurpessa	aurpessa
boriana	boriana	boriana
mon uedro	mon uedro	mont uedre
vallencia	vallencia	vallencia
cuiera	cugera	cugera
gandia	gandia	gandia
denia	denia	denia
cauo d(e) marti(n)	cauo de martina	cap de marti
carpi	carpi	calp
otillola	octilia	otillia
	cauo d'arcodra	cap d'arcodra
cantera	cantera	allacant
cauo iupo	cauo de iupo	cap de l'aljup
	fl(um)i de segura	flum segu(ra)
gardamar	guardamar	guardamar
Rows of significantly different names are highlighted. The toponyms in this table are in: Pujades i Bataller: (2007), pp. 386, 392.		

[90] Rosselló i Verger, Vicenç M.: 'Portolans procedents de col.leccions espanyoles segles XV-XVII : Catàleg de l'exposició organitzada amb motiu de la 17a Conferència Cartogràfica Internacional i de la Assemblea General de l'Associació Càrtografica Internacional (ICA/ACI) Barcelona' in: Institut Cartogràfic de Catalunya, (Barcelona: Institut Cartogràfic de Catalunya, 1995), pp. 345-371. p. 348.

[91] Pujades i Bataller: (2007), p. 491.

Hydrography

The hydrography of Dulceti's 1339 portolan chart is considered one of its most impressive aspects. Nordenskiöld appraised that it was superior to the maps of the prolific chart-maker Andrea Bianco nearly a century later.[92] Campbell noted a 1956 study by Clos-Arceduc, in which the hydrography of Dulceti's chart was found to be more accurate than Mercator's 1569 planisphere.[93] R. D. Oldham, in a 1925 study of the hydrography of the Rhône delta on early nautical maps, concluded that the 1339 Dulceti chart had one of the most accurate depictions, which was copied and recopied for three centuries, steadily deteriorating until land surveys reestablished the correct coastline.[94]

Dulceti not only drew a more accurate littoral than his predecessors, but was the first to include many new coastlines. Although rudimentary, both the Dulceti charts depicted the Baltic and Scandinavia more accurately than the Carignano map, and Dulceti was the first to include Norway. Campbell noted that the acquisition of hydrographic details northeast of Bruges after 1323 was nearly impossible for Mediterranean navigators due to restrictions imposed by the Hanseatic League, who had no cartographic tradition of their own.[95] Thus, no improvements were made on this region after Dulceti until the late fifteenth century. On his 1330 chart, Dulceti included two islands north of Scotland and west of Norway: '*staland*' and '*Insula oruaya*'. On the 1339 chart, they were labelled '*Insula scitilano*', and '*Insula orchania*', while a third was added: '*Insula chatenes*'. *Scitilano* and occasionally *Orchania* were often copied in later charts, and Campbell noted *Scitilano* might have been an early depiction of Iceland.[96]

Furthermore, the 1339 Dulceti chart was the first to include the Canaries, of which the three easternmost islands are depicted: '*Insula de lanzaratus marocelus*' (Lanzarote), '*iegi marim*' (Isla de Lobos), and '*laforte ventura*' (Fuerteventura). The cross of St George was painted over the island of Lanzarote in reference to the Genoese navigator Lancelotto Malocello, who, in the service of Portugal, was one of the first to travel to the islands since

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92 Nordenskiöld: (1964), p. 58.

93 Campbell: (1987), p. 386.

94 Oldham: (1925), pp. 408-409.

95 Campbell: (1987), p. 410.

96 Ibid. p. 414.

the Roman era, around 1326.[97] Another group of islands was depicted north of the Canaries, labelled '*Insulle sancti brandani siue puelarum*' (the islands of St Brendan or of maidens), with the three toponyms '*[?]ia aria*', '*Insula capraria*', and '*canaria*'. Fernández Duro mistakenly identified these islands as the Azores, but Armando Cortesão more convincingly argued that they were the first depiction of Madeiras, despite their first documentary mention nearly a century later in 1418-19.[98] Cortesão's proposition seems reasonable: the islands were depicted in (more or less) the correct location, and although the westernmost isle has been lost due to trimming, '*Insula capraria*' and '*canaria*' seem to be correctly oriented as the island of Madeira and the Islas Desertas. That Dulceti named one of them *Canaria* is unsurprising, the name having been derived from the *Naturalis Historia* by Pliny the Elder.[99]

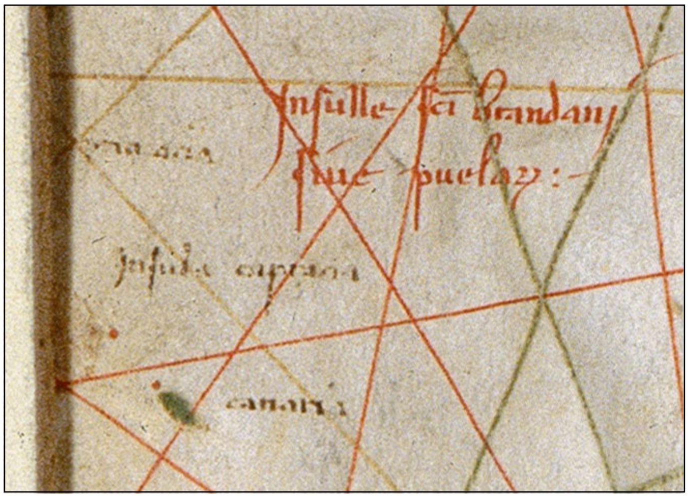

Figure 2.2.10: The Madeira Islands on the 1339 Angelino Dulceti map. Image courtesy of the Bibliothèque Nationale de France.

Dulceti additionally extended the hydrography of Africa; the 1313 Vesconte atlas extended as far south as '*zamor*' (modern Azemmour, 33°17'N), and all later atlases from 1318 onwards depicted up to to '*mogodor*' (modern Essaouira, 31°31'N). Perinus did not improve the African coast, despite having room to do so on his 1327 chart. Carignano drew the African coastline considerably beyond any before it, seemingly as far south as Cap Blanc, or even Dakar, but most of his littoral was unsubstantiated and derived from *mappaemundi*. Dulceti's 1330 chart depicted the coastline as far south as '*arzazara*' (probably near Laayoune in Western Sahara), and his 1339 chart extended, albeit crudely, the coast past Cape Bojador (which he labelled '*c. de nom*') to around 25° north with a final toponym '*polle*'. The first documented account of sailing past Cape Bojador was made by Portuguese

97 Abulafia, David: *The Discovery of Mankind: Atlantic Encounters in the Age of Columbus* (New Haven: Yale University Press, 2008). p. 37.

98 Cortesão, Armando: *The Nautical Chart of 1424 and the Early Discovery and Cartographical Representation of America: A Study on the History of Early Navigation and Cartography* (Coimbra: University of Coimbra, 1954). p. 47 As cited in: Campbell: (1987), p. 410 (note 294).

99 Pliny: *Natural History*, trans. by H. Rackham (London: William Heinemann, 1942), vol. II. pp. 488-491.

navigator Gil Eannes in 1434, nearly a century after Dulceti's chart. However, this does not indicate the cape was rounded earlier, simply that Dulceti decided to draw past what was definitively known, deriving the information from other maps (likely *mappaemundi* in this instance), mariners' tales, and imagination. Below '*c. de nom*', he indicated a possible source of information with the text: "Tota ista riperia (sic) maris [e]st desita nisi apiscatoris".[100]

Geographical Content and Decoration

The first portolan map to include any geographical content (as opposed to hydrographical content) was Giovanni da Carignano's map of c.1327. However, as was previously discussed, Carignano's map was a hybrid chart, almost as much a *mappamundi* as a portolan map. Dulceti however, in both his 1330 and 1339 maps, not only included and improved upon the best hydrographical and toponymic information of the time, but additionally incorporated significant details of the internal features of Europe, North Africa, and Asia Minor.

Both the internal content and decorative aspects were incredibly well-planned before the drawing of the map was executed. Given the extent of decorations and texts covering the map, there is little overlap or incongruities. Given their positioning, the major rivers (or at least their mouths) must have been drawn before the toponyms were written. Similarly, the positioning of the toponyms around the large depiction of (the old) St Peter's Basilica demonstrates that it must have been drawn or at least sketched first. The overall impression exuded from the map is that this was not a standard portolan chart to which decoration was added as an afterthought, but a carefully planned and integrated map made by an expert cartographer.

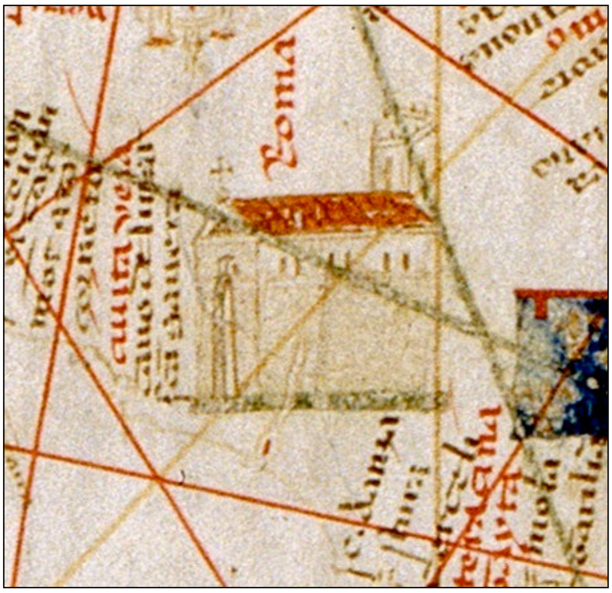

Figure 2.2.11: Saint Peter's Basilica depicted on the 1339 Angelino Dulceti chart. Image courtesy of the Bibliothèque Nationale de France.

[100] "All of this coast of the sea has been abandoned except by fishermen".

Geography

On his 1339 map, in large black capitols of alternating red and black ink, Dulceti labelled both Europe and Africa, and presumably Asia was also written, but was trimmed off (it was labelled on the 1330 chart as '*Assia*'). Additionally, several regions were labelled in slightly smaller gothic block capitols in the same alternating colours.[101] Many smaller territories were also labelled in lower case red ink, but in a larger script than the standard toponyms, including '*Frandria*', '*Bauaria*', '*Germania*', '*Sclauonia*', '*Burgaria*', '*armenia maior*', and others. Within these regions, numerous non-coastal cities were labelled, again in red ink, many with an associated city illustration and flag. Most city illustrations in Christian Europe included a tall tower with a cross, which were naturally absent from non-Christian regions. Without a specific symbol to denote the allegiance of other cities, flags were used. In eastern Europe, '*maurocastro*' (Maurokastron, modern Bilhorod-Dnistrovskyi, where the Dniester flows into the Black Sea) and '*uecina*' (a lost colony some 50-100 miles up the Danube from the Black Sea) were both depicted with flags of the Golden Horde, to note the westernmost extent of the Khanate under Uzbeg Khan at that time.

Rivers appeared to be of considerable importance, often flowing out of mountain ranges that were variously coloured in brown, indigo, and gold. Over twenty-five different rivers, not including tributaries, were depicted in blue ink such as the Danube, Rhone, Tajo, Don, Volga, Tigris, Euphrates, Jordan, and Nile. Along most of these rivers were written the names of many cites, very often accompanied by an illustration. Kristina Irás argued that the considerable trade routes into and through Hungary, which developed during the reign of Charles I (r. 1309 to 1342), were responsible for an increased focus on the Danube on Dulceti's two charts, and posited that maritime navigators were just as interested in the Danube and its navigable tributaries, as in the sea.[102] From the extensive depiction, the Danube river was clearly important, and although it did not follow a geographically accurate course through Europe, the interrelationship between its cities and tributaries was surprisingly accurate.[103]

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[101] These include, in Europe: '*Castela*', '*Hirlanda*', '*Anglietera*', '*Scocia*', '*Norveca*', '*Svecia*' (written twice), '*Allamania*', '*Itallia*', '*Gothia*', '*Ungaria*', '*Polonia*', '*Grecia*', '*Rutenia*', and '*Cumania*'; in Asia: '*Turchia*', '*Sciria*', '*Persia*', and '*Arabea Sabbea*'; and in Africa: '*Nubia*' (written twice), '*Egiptus*', '*Orgena*', and '*Ganuya*'.

[102] Irás, Krisztina: 'Hungary on Two Portolan Charts by Angelino Dulcert (1325/30, 1339)', *Imago Mundi*, 59: 2 (2007), 223-231.

[103] Ibid. pp. 226-227.

Flags

Figure 2.2.12: The flag of the Golden Horde depicted above the city of Sarai on the 1339 Angelino Dulceti chart. Image courtesy of the Bibliothèque Nationale de France.

One-hundred and ten flags were drawn on the 1339 Dulceti chart, plus the additional cross of Saint George painted upon the island of Lanzerote, and the cross of the Knights Hospitaller painted across Rhodes.[104] While many of these are unique, especially amongst coastal city-states, some flags were repeated across a region. Examples include: the Golden Horde, for which eleven cities depicted their flag, including their capitol Sarai on the Volga; the Ilkhanate Empire, for which eighteen flags of argent, a square gules were drawn; and Nubia, in the southeast corner of the map, where six flags of a red tri-barred Papal cross (the emblem of Prester John) were depicted. These last flags were associated with the following text as noted by Fernández Duro: "Scias que ethiopia habet imperatorem qui veneratur [?] Id est servus crucis etiam habet lxxij reges sub se".[105]

Exactly half the number of flags (55) were drawn on Dulceti's 1330 map. However, much of that difference can be explained by the greater geographical coverage and number of non-coastal cities on the 1339 chart. Nevertheless, there are some interesting noteworthy differences. No flags of the Golden Horde appear on the 1330 map, despite the appearance of seven of the ten cities which included them on the 1339 chart; the only city that did have a flag was Tanais on the Don River delta, which showed a white square on a field of red, similar to the flag of the Ilkhanate Empire, but with reversed colours. Several cities which had flags on both maps depicted different ones on each. On the 1330 map, '*sauasto*' (modern Sivas in Turkey), an important city on the silk road, flew the flag of the Ilkhanate, but on the 1339 map, flew a flag which was one half Ilkhanate, and the other half the Christian flag of medieval Armenia (the modern five-cross flag of Georgia). Naples, on the 1330 map, displayed a triangular flag of half-red and half-white, similar to its modern city flag, but on the 1339 map flew the flag of the House of Anjou. Despite the

[104] For comparison, Petrus Vesconte in his 1320 atlas included twenty-seven, possibly with an additional sixteen (if a central sheet of parchment was removed) flags, though he did not incorporate any internal geography or non-coastal cities.

[105] "Know that Ethiopia has an emperor who is respected [?] That is, this servant of the cross also has seventy-two kings under himself". See: Fernández Duro: (1888), p. 312.

Papacy having moved to Avignon in 1309, a red flag with golden crossed-keys was drawn above Rome on the 1330 map. However, the 1339 map had no flag at all, instead drawing a large illustration of Saint Peter's Basilica.

Unlike the flags depicted in Petrus Vesconte's *Liber secretorum* portolan maps which were seemingly copied identically from one atlas to another without much consideration, the evidence suggests Angelino Dulceti put thought into his vexillography. It has been established that Vesconte likely included flags at the behest of Marino Sanudo, with the purpose of inciting nationalist fervor and desire to engage in another crusade. What was the purpose behind Dulceti's inclusion of flags? Although later in the fourteenth century flags might have been a desired and expected inclusion amongst portolan charts (given how many extant maps included them), Dulceti was the instigator of this, not bound by it. Perhaps his patrons, having seen the widely-disseminated *Liber secretorum*, desired flags, which Dulceti provided. Perhaps alternatively (or additionally), Dulceti included flags with a didactic purpose in mind, to depict on his maps the geopolitical situation at the time. Although Campbell is correct in his assertion that mariners would have been very foolish to rely on a depicted flag to know the allegiance of their next port-of-call, they would have been informative to educated patrons with a curiosity about the world.

Political, Religious, and Historical Inclusions

Like many portolan charts that followed it, the 1339 chart of Dulceti included a number of additions that, similar to *mappaemundi*, were of historical, anthropological, political, or religious interest, and entirely unrelated to navigation. The first of these were depictions of monarchs in their associated territories, a motif which was adopted in many portolan maps. In Asia, Uzbeg Khan, who reigned over the Golden Horde from 1313 to 1341, was drawn in the northeast corner.[106] Unfortunately, a text next to the drawing,

Figure 2.2.13: Uzbeg Khan as depicted on the 1339 Angelino Dulceti map in Paris: BNF, Rés. Ge. B696. Image courtesy of the Bibliothèque Nationale de France.

[106] Above Uzbeg was written: "Hic dominatur vsbech dominus et inperator' de sara".

which likely referred to the Khan, is illegible in facsimile. Below the Caspian was written: “tera de bonsayt • dominus de tauris et de tota perssia”.[107] Busayid (Abu Said) Baghatur Khan ruled the Ilkhanate Empire from 1316 until his death in 1335. Although Dulceti’s information might have been four years obsolete, two figures were depicted below the inscription, which may represent multiple factions warring for control.

Figure 2.2.14: Busayid (Abu Said) Khan depicted on the 1339 Angelino Dulceti map in Paris: BNF, Rés. Ge. B696. Image courtesy of the Bibliothèque Nationale de France.

Across the Persian Gulf, in ‘*Arabia Sabbea*’, was depicted the Queen of Sheba. The Arabian peninsula was largely dominated at the time by Semitic Sabaeans, and it was in this land where texts such as the Quran and the Bible referred to the Queen. Dulceti demonstrated a superb knowledge of the world, including current monarchs many thousands of miles distant. His inclusion of a legendary figure therefore is unusual, but presumably he was without accurate information about the area. The longer text below her depiction is too illegible to be translatable, but it was possibly similar to one written on the 1439 Gabriel de Valseca chart.[108]

Figure 2.2.15: The Queen of Sheba depicted on the 1339 Angelino Dulceti map in Paris: BNF, Rés. Ge. B696. Image courtesy of the Bibliothèque Nationale de France.

In Africa, five kings were mentioned and one was illustrated, which were the king of Nubia, Prester John, the king of Orgena, the

[107] “The land of Busayid, lord of Tabriz and all of Persia”.

[108] “This land was ruled by the Queen of Sheba. Now it belongs to the Arabic Saracens. This Queen went to see King Salomon and brought him great gifts. And this land is rich in myrrh and incense, and in other fine products.” Pujades i Bataller, Ramón J.: *La Carta de Gabriel de Valseca de 1439*, trans. by Catalina Gironda Arguimbau (Barcelona: Lumen Artis Ediciones, 2009). pp. 357-358.

king of '*Garbo*', and Mansa Musa (illustrated). Nubia was labelled twice: one was surrounded by several tri-barred crosses of Prester John, whereas the other was labelled '*Nubia saracenorum*'. A text next to the Saracen Nubia reads: "Iste Rex saracenus habet continuet gueram con christianos nubie et ethiopie que sunt sub dominio Prest Jane christianus niger."[109] Below '*Orgena*' was a text that reads: "Iste Rex saracenus permanet senper [*sic*] in guera con saracenis maritimis • silicet tunixi".[110] To both sides were two nearly naked men, one leading a camel, and the other an ostrich, accompanied by the text: "Tera nigrorom qua senper [*sic*] vadunt nudi et sine aliqua vestimenta".[111] The king of Mali, '*Rex Melly*', was illustrated on the chart, and although not specified, this was probably Musa I (Mansa Musa), who ruled from 1312 to 1337. An associated text reads: "Iste Rex saracenus dominatur tera arenosa et habet mineries auro in masima habundancia".[112]

Figure 2.2.16: Mansa Musa of Mali depicted on the 1339 Angelino Dulceti map in Paris: BNF, Rés. Ge. B696. Image courtesy of the Bibliothèque Nationale de France.

In addition to the monarchs, there are several religious references, sometimes accompanied by an illustration. A common inclusion in later portolan charts, Dulceti was the first to follow the *mappamundi* tradition by illustrating the Exodus of the Hebrew slaves across the Red Sea (which he painted red), by depicting an isthmus, and the text: "Transitus filiorum Isdraellorum". In case any of his patrons mistakenly thought the Red Sea was actually red, he added: "Mare Rubrum • non tamem quod aqua sit rubea sed suudum".[113] Next to the illustrated city of Mecca, was another text: "in ciuitate ista est archa legis machomen qui permanet in aerem proximitem cala…"[114] Farther north between the Tigris

[109] "This Saracen king has continued war with Nubian and Ethiopian christians who are under the rule of the Nigerian christian Prester John".

[110] "This Saracen king is always permanently at war with maritime Saracens, certainly with Tunis."

[111] "The land of black men, who always go naked and without clothing".

[112] "This Saracen king rules the sandy earth and has gold mines in great abundance".

[113] "Red Sea: not however that the sea is red, but bright."

[114] "In this city is the ark of laws of Muhammad, which permeate into the air…"

and Euphrates, was depicted the Tower of Babylon: "Issa est alta tria milia pasuum • inde an pla pasaum xvi • Ture de Babe".[115] Beyond that was Noah's Ark, drawn atop a mountain: "Archa de Noe • mons ararat in quo permansit archa Noe post diluuium."[116] Other religious buildings included: the Church of the Holy Sepulchre in Jerusalem, the monastery of Saint Catherine on Mount Sinai, surrounded by mountains, and the Cathedral of Santiago de Compostela, an important pilgrimage site in Galicia. Dulceti's 1330 chart depicted both the Holy Sepulchre and Santiago de Compostela, and all were included in the attributed British Library chart.

Other tracts of text around the map put a geographical location on interesting historical, anthropological, zoological, and economic facts. Next to '*Egiptus*', the following was written: "Nota quod Egiptus habet deserta mala in quibus sunt multa animalia monstruosa ibi pardi, tigrides, babilischi, aspides, et serpentes oribiles, et elefantes."[117] This text, reminiscent of *mappaemundi*, reappeared in many later portolans, in varying locations in Africa. Unlike *mappaemundi* however, no known portolan charts depicted pseudo-human races, such as dog-headed cynocephali, or the one-legged monopods. Instead, portolan maps generally referenced more tangible curiosities, about which were was at least some evidence, or trade interest. Near Norway was a picture of a falcon, with the note: "Hic sunt gisfalcos." Gyrfalcons were prized birds-of-prey amongst European nobility, who would have been interested to know their provenance.

A lengthy text in the northwest corner of the map discusses Ireland:

> "In Hibernia que Irlanda dicitur sunt multa mirabilia que credenda sunt, ut narat [*sic*] Iussidolus. Est autem in Ibernia insula quedan parva in qua homines nonquam moriuntur. Sed quando nouo senio aficiuntur ut moriantur, extra insulam deferuntur. Est alia insula in qua sunt arbores quibus aves portant et sicut papones maturant. Item est allia Insula in qua mulieres pregnantes nonquam pariunt sed quando sunt determinate ad peperiendon extra insulam deferentur secundum consuetudinem. Nulus [*sic*] est serpens, nula rana, nula

[115] "The actual Tower of Babylon is three miles high: thence sixteen times as many paces".

[116] "Ark of Noah: Mount Ararat at which Noah's ark remains after the flood".

[117] "Note that Egypt has a terrible desert in which there are many monstrous animals: pards, tigers, basilisks, asps, and horrible serpents, and elephants".

aranea venenosa ymo tota tera [*sic*] est contraria adeo venenosis tera ut idem delata et dispersa pereant."[118]

Dulceti noted in this tract of text that his source of information was Isidore of Seville. Specifically, this would have been Isidore's *Etymologiae*, written in the seventh century. Book XIV, chapter VI, paragraph five briefly discussed Ireland, but did not give nearly as much detail, nor did it mention immortal men or ever-pregnant women, which Dulceti must have gleaned from elsewhere.[119] As Fernandez Duró observed, a nearly identical tract about Ireland appeared in the Catalan Atlas.[120]

Another lengthy text was written about Italy:

> "ITALLIA. Hec Regio est magna: Inter omnes autem regiones Europe occidentalis Itallia optinet principatum, insulas enim huc nobiles et potesta maris insignes, prouinciis, diuiciis, contis locupletas, ciuitates populisisimas [*sic*], muris fosatis, et aliis aparatibus belicis nimis fortes, auri et argenti copias habundantes ipsa uera comprehendit pars lumbardie usque calabriam et apononiam finitur."[121]

No other region did Dulceti so highly praise, and unlike most portolan charts, Dulceti labelled and drew figures for many non-coastal cities of Italy, such as '*bononia*' (Bologna), '*perusium*' (Perugia), and '*mediolanom*' (Milan). Contrary to those scholars who believed in his Majorcan heritage, his focus on Italy provides additional evidence he was Italian, even if working in Majorca.

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[118] "In Hibernia which is called Ireland there are many marvellous (things) which are believed, as Isidore narrated. But there is in Ireland a certain small island on which men never die. But when the extraordinarily old are afflicted as they wither, they are carried off the island. There is another island on which there are trees which bear forth birds and in the same way as butterflies mature. Likewise, there is another island on which pregnant women never give birth but when they are at the limits of pregnancy(?) they are carried off the island according to custom. There are no snakes, nor frogs, nor venomous spiders, on the contrary the whole of the land is truly incompatible with poisons, indeed in order to destroy the poison the same land carries away and disperses it".

[119] Barney, Stephen A. et al.: *The Etymologies of Isadore of Seville* (Cambridge: Cambridge University Press, 2006). p. 294.

[120] Fernández Duro: (1888), pp. 293-294.

[121] "Italy. This region is great: amongst all the regions of western Europe Italy maintains its supremacy over the islands of the eminent sea, for here nobles and the powerful embrace for themselves provinces, wealth, enriching oration, populous cities, walls, ditches, and excessively mighty appurtenances of war, and abundant supplies of gold and silver, defined as the regions of Lombardy up to Calabria and the Apennines".

Dulceti's inclusions of monarchs, sites of religious and historical significance, and geographical, anthropological and zoological information demonstrate the map's scholarly and aesthetic function. As the reconstruction showed, these inclusions would have taken a long time to add to the map, probably in this case longer than it would have taken Dulceti to draw the rhumb network, coastline, and write the toponymy. These inclusions would have made the map more costly, and a more valuable map most likely would not have been taken to sea to be used for navigation. Instead, the purpose of all three of Dulceti's charts were as visual encyclopaedias. The facts about Europe, Africa, and the Middle East were surprisingly up-to-date: Dulceti knew about Uzbeg Khan, the Ilkhanate, and perhaps even about how the latter's dissolution had changed the geopolitical situation in Asia Minor, demonstrated by altered flags. In a way, these inclusions suggest that Dulceti's charts were more akin to *mappaemundi*, than to nautical charts, except that Dulceti used a more accurate geography.

Successors

Although only two or possibly three of Dulceti's charts survive, he made a lasting impression on future cartography made in Majorca, and other centres of production. Pujades noted that both Cresques Abraham and his successors, and Guilermo Soler were "direct heirs" to Dulceti's cartography.[122] Both his style and toponymy were adopted by several other Majorcan chart-makers, and a few Italian ones, including the following:[123]

✤ Duane and Francisco Pizigano (Venetian). As seen in: 1367 chart (Parma: Biblioteca Palatina, MS. Parm. 1612.

✤ Guilermo Soler (Majorcan). As seen in: 1368-1385 chart: Paris: BN, Rés. Ge. B1131.

✤ Cresques Abraham and his atelier (Majorcan). As seen in: c.1375 'Catalan Atlas': Paris, BN, MS. Espagnol 30; Anon. last quarter 14th cen. Naples, Biblioteca Nazionale, MS. XII, D102; Anon. end 14th cen. Paris, BN, Rés. Ge. AA751.

✤ Albertin de Virga (Genoese working in Venice). As seen in: Anon (attributed), beginning 15th cen. Venice, MC. port 40.

✤ Mecia de Viladestes (Majorcan). As seen in: 1413 chart: Paris, BN, Rés. GE. AA566.

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[122] Pujades i Bataller: (2007), p. 491.

[123] All images until 1470 were viewed on: Pujades i Bataller (2007), DVD supplement. Images of maps after 1470 were searched for online, and in texts, but not every map after 1470 could be viewed, so the list is incomplete from that year onwards.

- ✤ Batista Becharius (Genoese). As seen in: 1426 chart: Munich, Bayerische Staatsbibliothek, Cod. Icon. 130.
- ✤ Gabriel de Valseca (Majorcan). As seen in: 1439 chart: Barcelona, Museu Marítim, Inv. 3236 ; Anon. (attributed) c.1440 chart: Florence, BNC, port. 16.
- ✤ Rafael Soler (Majorcan). As seen in: Anon. (attributed to atelier) 2nd quarter 15th cen. chart: Paris, BN, Rés. Ge. B8268.
- ✤ Bartolomeo Pareto (Genoese). As seen in: 1455 chart: Rome, BNC, CN1.
- ✤ Petrus Roselli (Majorcan). As seen in: 1464 chart: Nuremberg, GN, MS. La. 4017; 1465 chart: London, BL, MS. Egerton 2712; 1466 chart: Minneapolis, JFBL, S.S.; 1468 chart: New York, HSA, K35; Anon (attributed) 3rd quarter 15th cen.: Modena, Biblioteca Estense e Universitaria, C.G.A.5b.
- ✤ Albinus de Canepa (Genoese). As seen in: 1480 chart: Rome: Società Geografica Italiana, Rari Z B 17834; 1489 chart: Minneapolis, JFBL, B1489mCa.

By the end of the fifteenth century, Dulceti's influence had been synthesised into the genre. There are even sixteenth century charts that retain some of his features, such as kings, and the Danube river basin. It is clear that Dulceti's style and inclusions beyond the standard coastline, toponyms, and rhumb network, were appreciated and imitated by numerous chart-makers for over a century, which indicates the market for maps with these extraneous inclusions must have been significant. Encyclopaedic and aesthetic portolan charts, like those of Dulceti, were too valuable to have been used at sea for navigation.

Conclusion

Angelino Dulceti was the first prolific portolan chart-maker to adopt a style of mapmaking that combined the encyclopaedic and didactic aspects seen on large *mappaemundi*, with the coastlines of the Mediterranean, Black Sea, and Atlantic Europe. In addition to some *mappamundi*-derived inclusions, Dulceti also included facts about modern geopolitics, incorporated flags, described modern monarchs and their territories, and noted economic aspects of interest to merchants, who would have been his primary patrons. Although he must have worked for a number of years, it is impossible to hypothesize what his total cartographic output may have been, and whether he made unembellished maps to sell to navigators. The near-perfect integration of toponyms, coastline, illustrations, and text in both his 1330 and 1339 maps demonstrates that Dulceti was a skilled cartographer, who was a lasting influence for over a century.

The 1403 Chart of Franciscus Becharius

The survival of the 1403 chart of Franciscus Becharius is extremely fortuitous. It is his only extant map,[124] and unlike many chart-makers who were mere copyists of earlier maps, introducing little new material, Becharius was interested in cartographic improvement.[125] The chart included what has been called his 'Address to the Reader', a lengthy and important text discussed in detail below. Though debatable, the chart may also be the very first to include an original latitude scale, which if true, pushes the arrival of this important innovation back by over a century. In a letter to the prominent book-dealer Hans P. Kraus, cartographic historian Roberto Almagià said it was "perhaps the most important nautical chart discovered for at least the past 30 years."[126]

The Artist and Cartographer

Little is known about Franciscus Becharius (more often published in the Italianised form, Francesco Beccari). He was Genoese by birth, but was known to be in Barcelona in 1399-1400, and Savona in 1403. Though he might have made maps in Genoa, there is no evidence. Although some scholars have thought his son Batista operated in Genoa, his two signed maps dated 1426 and 1435 only indicate that he was a citizen of Genoa ('civis Janue'), not that he made the charts there.[127] According to a contract document brought to light by Skelton, Becharius was commissioned to decorate four *mappaemundi* which were drawn by Jacme Ribes.[128] In the contract, Becharius was referred to as "dipintore di charte da navichare", thus it can be assumed he was an accomplished artist by trade, who produced decorated maps. However, if he did make decorative portolan charts like those by Dulceti, they have not survived: his chart of 1403 only has a few (albeit highly skilled) decorations. The three charts signed or attributed to Batista Becharius were moderately to significantly decorated: he probably learnt his artistic skills from his father.

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[124] A copy of one of his charts was made in the 1489 Cornaro atlas: London: BL, Egerton, MS. 73, 8v-11r.

[125] Sheehan, Kevin E.: 'Utility and Aesthetic: The Function and Subjectivity of Two Fifteenth Century Portolan Charts', *The Portolan*, 83 (2012), 7-23. pp. 9-10, 20.

[126] Kraus, H.P.: *Twenty-Five Manuscripts* (Vaduz, Liechtenstein: Rare Books, 1961). p. 62.

[127] Skelton, R. A.: 'A Contract for World Maps at Barcelona, 1399-1400', *Imago Mundi*, 22 (1968), 107-113. pp. 107-108.

[128] Ibid. p. 107. Jacme Ribes was the Christian post-conversion name of the Majorcan Jewish chart-maker Jefuda Cresques, the son of Cresques Abraham, author of the c.1375 Catalan Atlas.

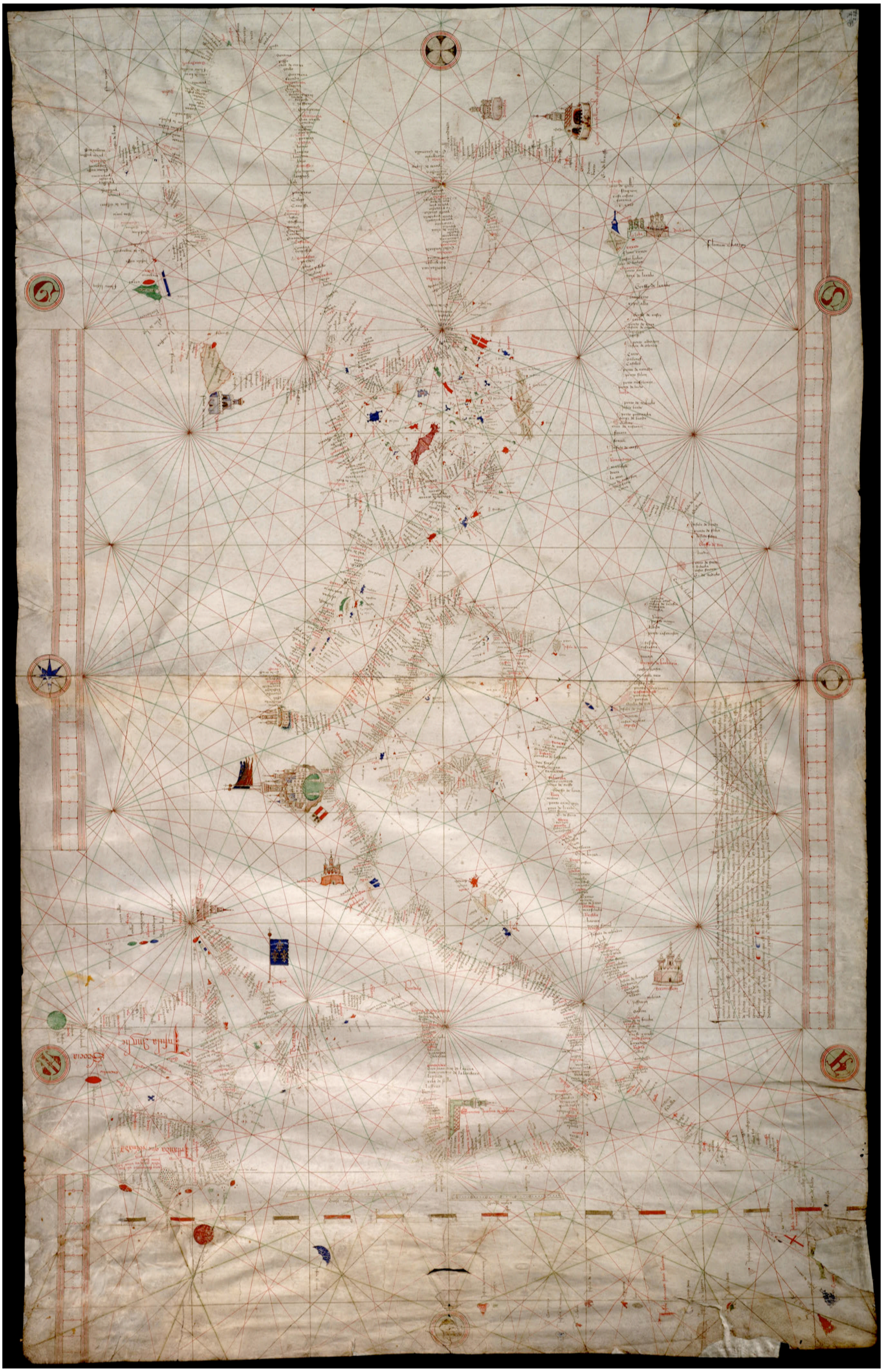

Figure 2.3.1: The Franciscus Becharius chart of 1403 (New Haven: BRBML, 1980.158). Image courtesy of the Beinecke Library, and available at: http://brbl-zoom.library.yale.edu/viewer/1027149 [Accessed 12 November 2013].

The 1403 Chart

The 1403 Becharius chart[129] is in excellent condition, was constructed of two pieces of parchment glued together vertically, and is larger than most, measuring 127 cm wide by 80 cm tall.[130] It appears to have been trimmed by an unknown amount on its western side at some point, as evidenced by a scale bar that runs off the edge of the map. The hydrographic coverage of the map includes the Black Sea, Mediterranean, European Atlantic coast as far as Denmark (‘*dacia*’), and the Atlantic African coast to just south of Tarfaya, in southern Morocco. The rhumb network was constructed of a single circle, and is entirely standard, with black, red, and green lines. Three scale bars are found on the map, laid out in the manner invented by Petrus Vesconte. The scale of the map, as determined by Pujades’ measurements, is a rather large 1.6 cm per 50 *miglia*. Most portolan charts and atlases were copied at a scale much closer to 1.0 cm : 50 m. This large scale allowed Becharius to be more detailed in his drawing of the littoral, and to include more toponyms; Pujades noted that he was the first to introduce many new place-names along the coast of Catalonia.[131]

‘Address to the Reader’

The most immediately apparent aspect of the 1403 Becharius chart is the explanatory ‘Address to the Reader’, shown in figure 2.3.2. A translation of the Latin text by H. P. Kraus is reproduced below:

> “Franciscus Becharius, citizen of Genoa, made the present chart in the city of Savona, February, 1403. The said Franciscus makes public, for the removal from all persons of any matter of doubt and bears witness to all those who do or shall sail the ocean sea, that he in this and other charts, all made by him, from after A.D. 1400, lengthened the distance of the coasting navigation of the ocean sea by a certain length of miles or leagues, more than the aforesaid Franciscus and others used to set forth upon the large charts, both

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[129] New Haven: BRBML, 1980.158.

[130] Pujades and the Beinecke Library website incorrectly published that the size of the map is 139.5 cm x 93 cm, but this measurement included the wooden frame in which the portolan is currently mounted. A librarian at the Beinecke Library was able to confirm the exact dimensions of the map.

[131] Pujades i Bataller: (2007), pp. 461, 480, 493.

those that were Catalan, Venetian, Genoese, as well as others who made navigational charts in past times. And especially in the coast of Portugal, viz., from Cape St. Vincent even to Cape Finisterre, and in the coasting navigation or the shores and places of Vizcaya and the coast of Bretagne and of the island of England; the marrow of the truth having been discovered concerning these [things] aforesaid through the efficacious experience and most sure report of many, i.e. masters, ship-owners, skippers and pilots of the seas of Spain and those parts and also of many of those who are experienced in sea duty, who frequently and over a long period of time sailed those regions and seas. And forasmuch let no one be amazed the two forms of charts are found from the hand of the aforesaid Franciscus which are dissimilar in this point, since he himself followed the reckoning of other charts and the forms and traces of old masters, and that badly. And also, it was several times reported to me, the aforesaid Franciscus, by many owners, skippers and sailors proficient in the navigational art, that the island of Sardinia which is in the Sea, was not placed on the charts in its proper place by the above mentioned masters. Therefore, in Christ's name, having listened to the aforesaid persons, I placed the said island in the present chart in its proper place where it ought to be. And therefore let this be known to you, the owner of this chart and all the others to whom it many concern."[132]

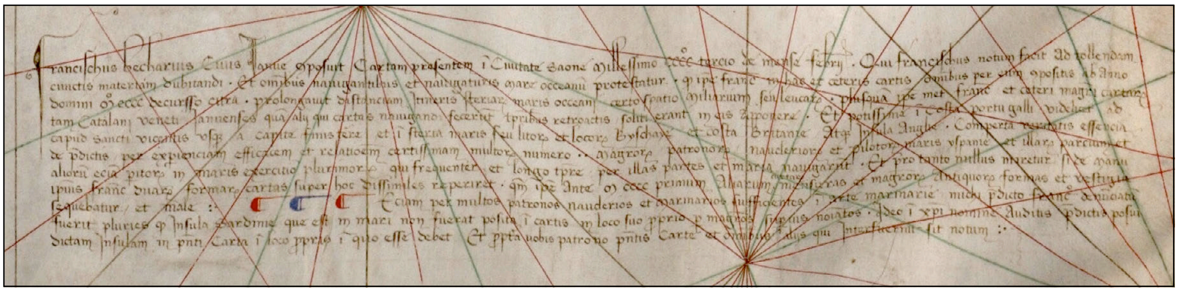

Figure 2.3.2: The 'Address to the Reader' appearing on the Franciscus Becharius chart of 1403 at Yale: Beinecke Rare Book and Manuscript Library, 1980.158. Image courtesy of the Beinecke Library.

Historically, this text is highly significant. It cannot be known whether Becharius included a similar text on other charts, but even if so, its survival is fortuitous because it reveals much about the nature of cartography at the time. Primarily, the text indicated that there was dialogue between Becharius and those whose livelihood involved navigating the sea, i.e. "masters, ship-owners, skippers and pilots", suggesting that this was the primary

[132] Kraus: (1961), pp. 63-64.

method by which chart-makers obtained new information.[133] As Campbell discussed, there was no indication that the hydrography was ever reviewed by expeditions of maritime surveyors, and thus they were reliant on word-of-mouth.

Furthermore, the text suggests that the function of the map might have been to serve as an exemplar from which other maps would be copied.[134] Unfortunately, it cannot be known for certain if this was the case, especially if Becharius added this or a similar text to every map he created, but his intention seems to have been to convince others that this map was more accurate. The new Becharius model was the first to replace those made by Angelino Dulceti and Petrus Vesconte several decades earlier. Pujades noted that all Majorcan cartographers adopted Becharius' hydrographic changes, including Gabriel Vallseca and Petrus Roselli.[135] His style of mapmaking and certain motifs – largely proliferated through his son Batista – were also adopted by many, including Gratiosus Benincasa.[136]

The fact that Becharius chose to include this text indicates the conservative nature of portolan production. Franciscus explained carefully why there were two different forms of chart by him, and that the latter was more accurate. Like the dissemination of medieval texts which were reproduced by monastic scribes, laymen scribes, and university students, portolan charts were copies of copies, often without the introduction of new material. Because any deviation from what mariners were familiar with would have been approached with a great deal of apprehension and scepticism, Becharius had to explain that his new map was better. Moreover, the text could be interpreted as a self-endorsement, advertising that only his new and improved maps should be bought.[137]

The text, and the changes made on the map itself, demonstrate that Becharius was an innovator, or a true cartographer. Campbell discussed the inherent conservatism of most portolan map-makers, and stressed that many charts ignored new information either out of lack of relevance or because of practical limitations.[138] Pujades posited that from 1404 onwards, little new material was contributed to the genre, and that most map-makers

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[133] Campbell: (1987), p. 428.

[134] Sheehan: (2012), p. 10.

[135] Pujades i Bataller: (2009), pp. 307-308.

[136] Sheehan: (2012), p. 10.

[137] Ibid.

[138] Campbell: (1987), pp. 414-415.

simply adopted and reproduced elements from their predecessors.[139] Many portolan chart-makers, with the noted exception of Franciscus Becharius, were no more than skilled copyists and artists, who either lacked the skill to make cartographic improvements, or had no desire to.[140] Although Kraus stated that this portolan was "the original record of a major scientific discovery of the Middle Ages,"[141] it could instead be that Becharius was simply enough of a revolutionary to make changes that were already well-known, but that no former maker had yet altered.[142]

Pujades argued that the text and hydrographic alterations demonstrated that portolan charts were utilitarian navigational instruments that "had to be perfected progressively".[143] However, the desire to perfect the mapped world does not prove that portolan maps were navigational. Actual improvements were few and far between (certainly after the early fifteenth century), and there is little evidence for a progressive perfecting of portolan cartography. Additionally, there could have been numerous other reasons Becharius had for wanting to improve his maps; perhaps a scholastic or even theological desire to more accurately depict the world, or, quite bluntly, to sell more maps by implying that his competitors' products were obsolete.

The fact that problems with the hydrography were recognised by mariners does indicate that these charts were being consulted in some navigational way. However, the fact that it took decades to realise and correct the problems suggests that maps were not used regularly for pilotage. It could be that seafarers who owned the maps for aesthetic, administrative, or scholarly reasons, worked out the incorrectness of the maps without using them at sea, or through comparison with written sailing directions. That it had been mariners who discovered a problem with the maps does not necessarily prove they were used for navigation.

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139 Pujades i Bataller: (2007), pp. 478-479, 483.

140 Sheehan: (2012), pp. 7-23.

141 Kraus: (1961), p. 66.

142 Sheehan: (2012), p. 10.

143 Pujades i Bataller: (2007), p. 461.

Hydrography

The hydrography of the map, other than the two aforementioned alterations discussed in the 'Address to the Reader', was fairly standard. The islands of the Atlantic were typical, and included the Canaries, Madieras, and possibly the Azores. Cortesão maintained that the island of '*bracir*', which first appeared on the 1367 Pizigani chart, was Terceira of the Azores, but many scholars have disagreed with his position.[144] The full chain of islands seen on the Becharius chart were first depicted either on the Catalan Atlas (c. 1375) or the c.1380 Guillem Soler chart (if it was earlier), where they were labelled, along with the Madeiras, the '*Insule Fortunate Sancti Brandani*', though a more rudimentary group of islands were labelled on the 1339 Dulceti chart, as discussed above.

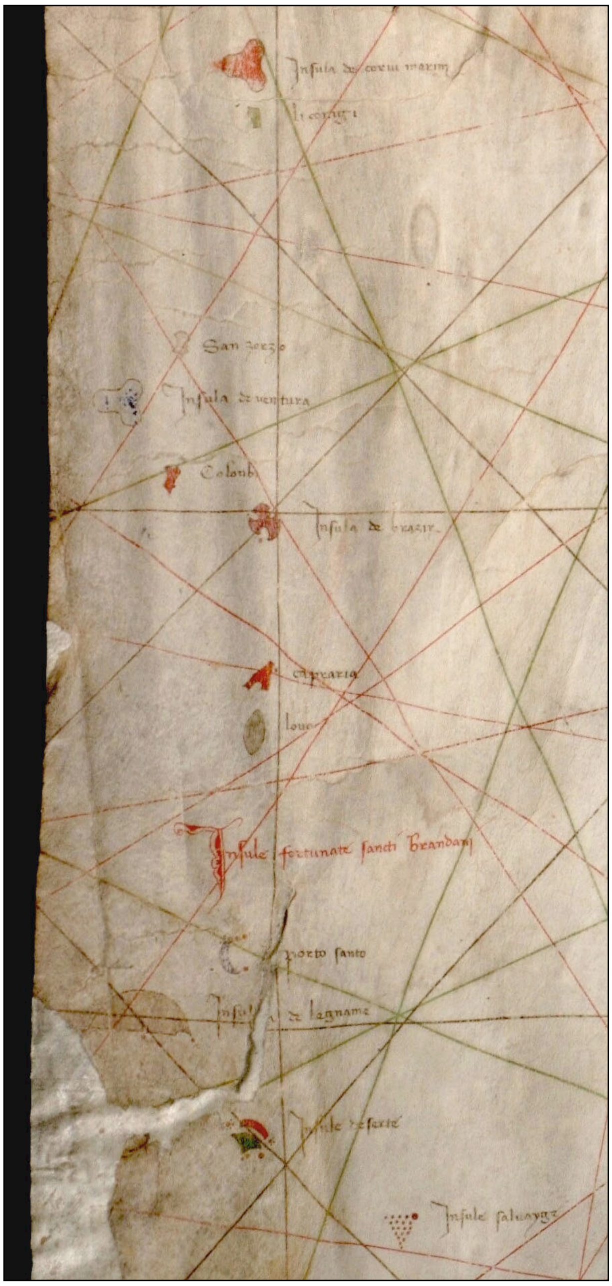

Figure 2.3.3: The 'Insule Fortunate Sancti Brandani' on the 1403 Franciscus Becharius chart. Image courtesy of the Beinecke Library.

In the 'Address to the Reader', Becharius stated that he made two major hydrographic changes: a lengthening of the European Atlantic coastline, and a repositioning of the island of Sardinia. Many scholars had discovered that the scale of the Atlantic was considerably smaller than the Mediterranean, and had been since the earliest portolan charts. Kelley suggested the difference averaged about sixteen percent, whereas Campbell noted Clos-Arceduc's estimation of thirty percent.[145] Figure 2.3.4

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[144] Campbell: (1987), pp. 410-411 (note 295).

[145] Kelley Jr., James E.: 'Non-Mediterranean Influences That Shaped the Atlantic in the Early Portolan Charts', *Imago Mundi*, 31 (1979), 18-35. p. 22; Campbell: (1987), p. 414 (note 312).

depicts superimposed coastlines of the Becharius chart and the 1339 chart of Angelino Dulceti, from Genoa to Denmark (‘*dacia*’). It is apparent that while Becharius did lengthen the Atlantic littoral, enough to note the change, Franciscus did not enlarge the scale of the Atlantic nearly enough.

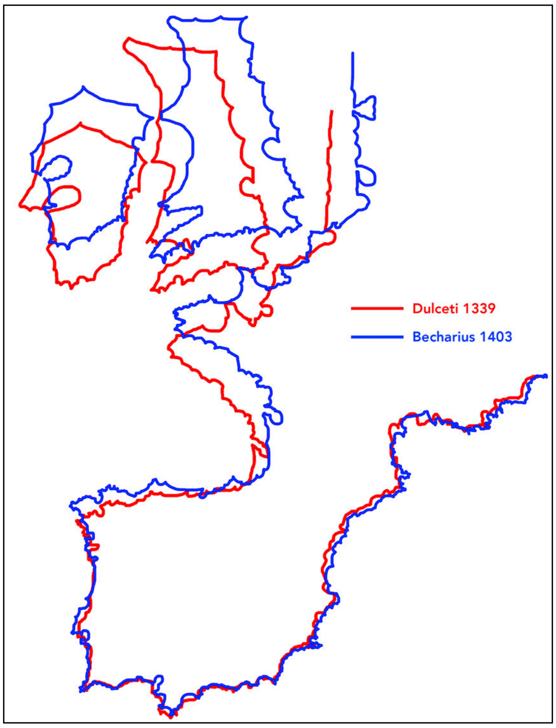

Figure 2.3.4: A superimposition of the western Mediterranean coastlines of the 1403 Franciscus Becharius chart and 1339 Dulceti chart. Digital tracings made from facsimiles courtesy of the Beinecke Library and the Bibliothèque Nationale.

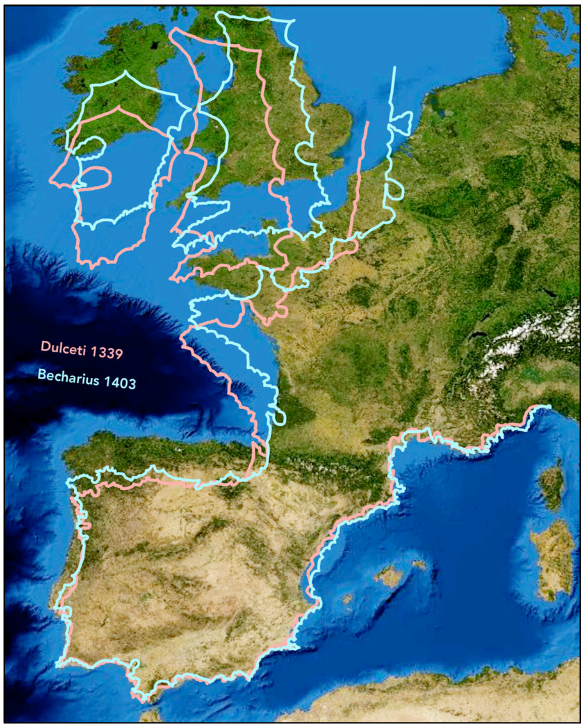

Figure 2.3.5: The coastlines from the preceding figure, superimposed over satellite imagery, scaled and rotated to best fit the Mediterranean littoral. Satellite imagery was provided by Stephanie Oliver using ArcGIS, on a loximuthal projection.

The second hydrographic alteration to which Becharius referred was a repositioning of Sardinia, though he did not specify how it was incorrect on earlier maps. Wagner noted that before 1403, Sardinia was usually placed too far south on charts. Figure 2.3.6 depicts the coastlines of Becharius’ 1403 chart and Dulceti’s 1339 chart. These two maps were chosen for comparison because of their incredible overall similarity, which indicates that Becharius used an exemplar from the Dulceti lineage of chart reproductions. It would appear that, at least from this comparison, Becharius did not so much move Sardinia as shorten it significantly. However, like the Atlantic coastline, it seems Becharius did not

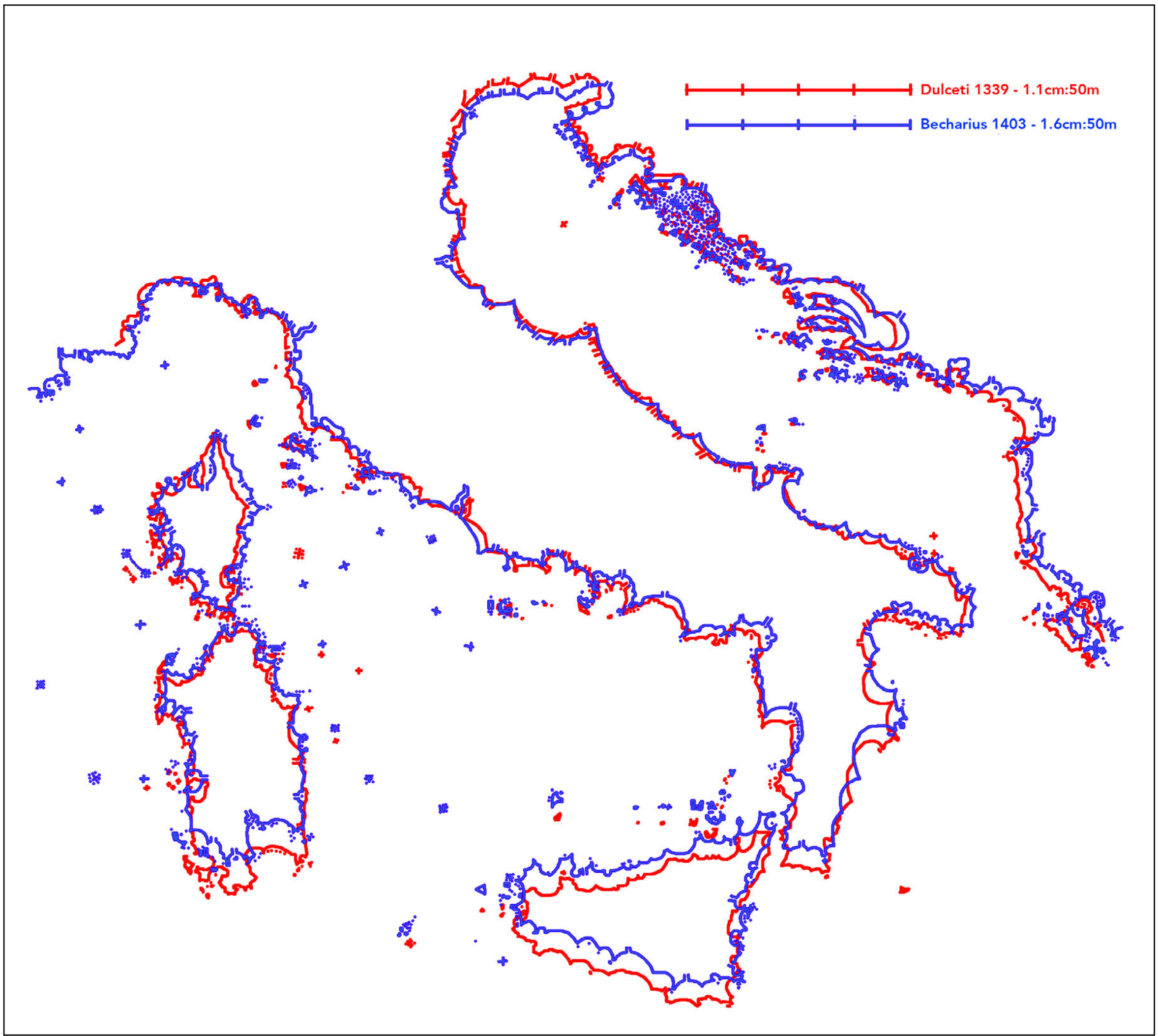

Figure 2.3.6: A superimposition of the Italian coastlines from the 1403 Franciscus Becharius chart and 1339 Dulceti chart. Digital tracings made from facsimiles courtesy of the Beinecke Library and the Bibliothèque Nationale.

alter the position of Sardinia enough, as can be seen in figure 2.3.7 which superimposes these coastlines over the actual earth. Overall, while Becharius recognised the hydrography was erroneous, he did not realise exactly how, or to what extent. This suggests that the mariners from whom Becharius gathered his information were not entirely aware of the exact problems either, only that there were issues, which indicates that portolan charts were potentially only vaguely consulted and not used daily for navigation.

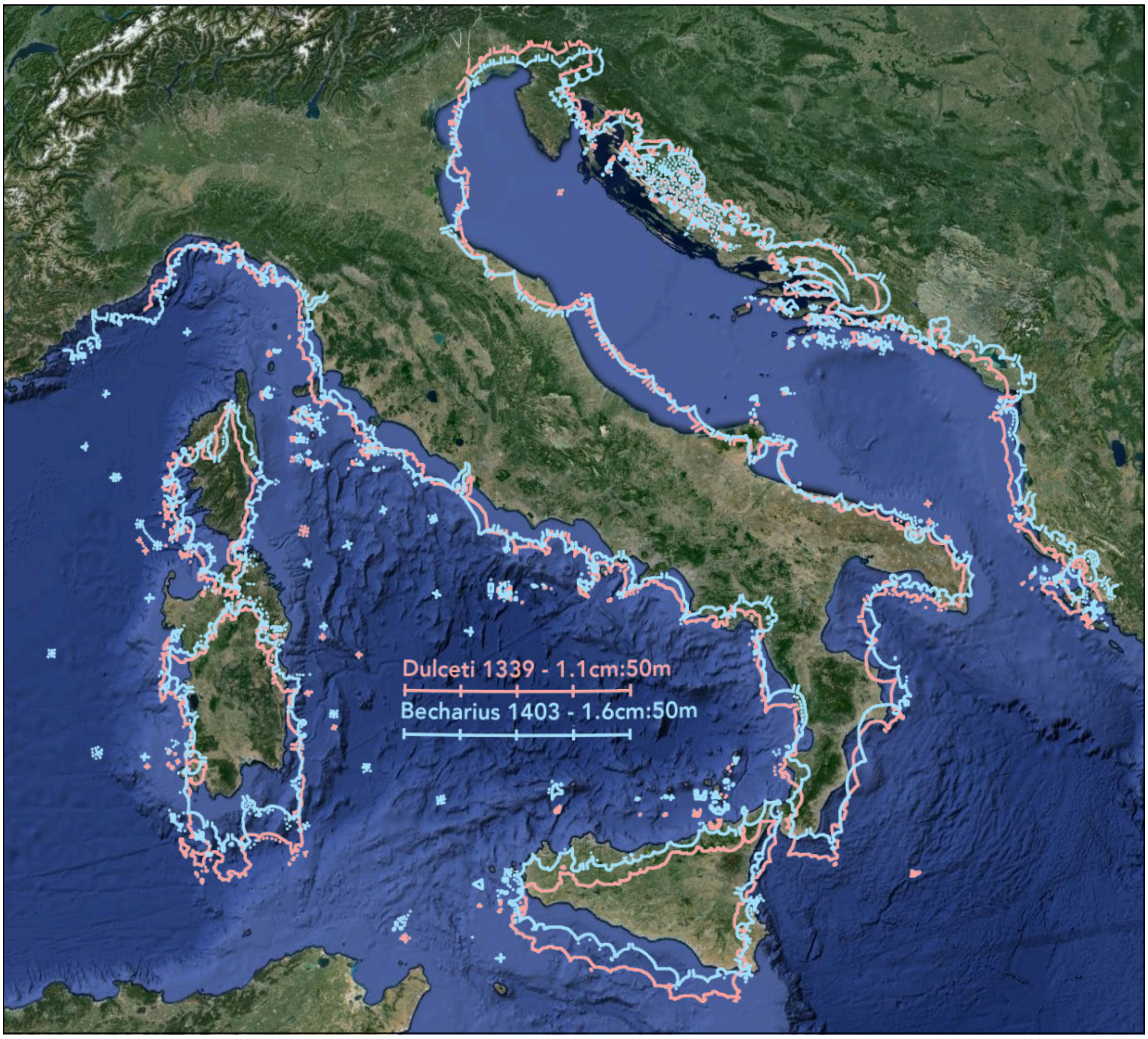

Figure 2.3.7: The Italian coastlines from the preceding figure superimposed over satellite imagery, scaled and rotated to best fit the Mediterranean littoral. Digital tracings made from facsimiles courtesy of the Beinecke Library and the Bibliothèque Nationale, satellite image courtesy of Google Earth.

Distance Scales

Included in the Atlantic, and alongside a scale of latitude (discussed below) are two distance scales: one reads '*Śpaneis mylen*' (Spanish miles) and has a measurement of 13.9 mm to fifty miles, while the other is labelled '*Duitſe mylen*' (Dutch miles) and has a measurement of 16.8 mm to fifty miles. It is unknown whether these scales were drawn by Becharius or were a later addition. Although they would appear to be contemporaneous, the scales are labelled in a script that is similar − but not identical − to Becharius' handwriting. The highly angular 'd' in '*Duitſe*' is unlike any he used elsewhere on the map, and the 'y' in '*mylen*' gently curves to the left and stops, whereas on Becharius' toponyms, the 'y' curves to the left, then back down again. However, Becharius did make a change in the scale of his charts, which was discussed by Kelley.[146] Whereas former charts, beginning with the *Carte Pisane* had used the Spanish *miglia*, Becharius was the first to change the scale to the slightly shorter Genoese unit.

Latitude Scales

A scale of latitude is present on the map, running from 27º north to 56º north, and located in the Atlantic. It has generally been assumed that this latitude scale was added at a later date; the equator and tropics were only first depicted on the c.1500 La Cosa Planisphere,[147] and the earliest full latitude scale first appears on either the Pedro Reinel chart (debatably dated to c. 1504), or a chart by Niccolò Caveri (also debatably dated c.1505)[148] or the c.1514-15 Atlantic chart of Ottemano Freducci.[149] Methods of calculating latitude had been known in antiquity, and to Arabic astronomers, and by the high Middle Ages, the use of the cross-staff,

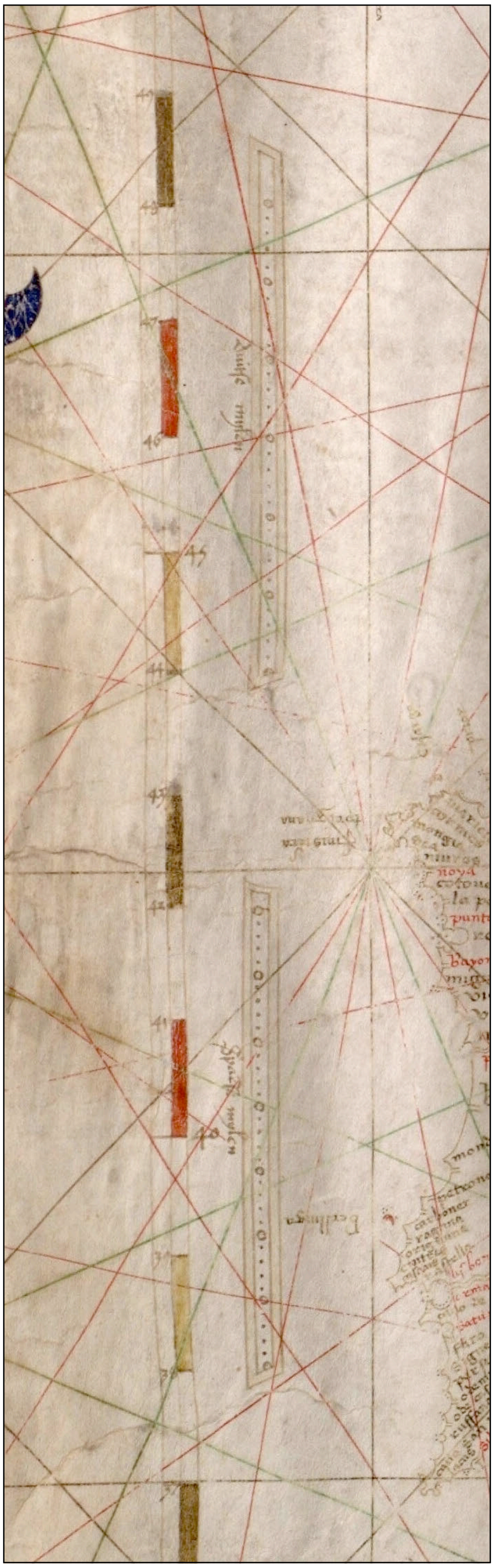

Figure 2.3.8: The latitude scale, and distance scales of Spanish and Dutch miles, appearing on the 1403 Franciscus Becharius chart. Image courtesy of the Beinecke Library.

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[146] Kelley Jr.: (1979), pp. 18-19.

[147] Campbell, Tony: 'Portolan charts from the late thirteenth century to 1500: Additions, Corrections, Updates', (2011) <http://www.maphistory.info/portolanchapter.html> [accessed 8 May, 2011].

[148] Lepore, Fortunato et al.: 'The autumn of mediaeval portolan charts. Cartometric issues', *e-Perimetron*, 7: 1 (2012), 16-27. p. 17.

[149] Astengo: (2007), p. 193.

quadrant, (and later) astrolabe, was not uncommon amongst the highly educated; a letter from 1024 described how a 'magister' in Cologne had acquired a valuable astrolabe.[150] On the rolling decks of a ship, these early instruments were cumbersome and often inaccurate, but measuring latitude was not necessary for Mediterranean navigation, because of both its long narrow shape and its subdivision into basins. It has been suggested that the invention of the mariners' astrolabe may be credited to thirteenth-century Majorcan polymath Ramón Llull, but the earliest specific mention of latitude measurements being made on board ship dates to 1462, by Portuguese navigator Diogo Gomes, in the exploration of the Atlantic.[151]

Nearly every scholar who has studied the Becharius chart has believed the latitude scale was a later, sixteenth-century addition. However, in a recent article by Lepore, Piccardi, and Pranzini, it was suggested that the latitude scale was contemporaneous with the original construction of the chart.[152] Their reasons were as follows: the inks and pigments used on the latitude scale and on the rest of the map do not appear to differ in appearance; the lines of the rhumb network appear to overlay the latitude scale; and unlike other maps where a latitude scale has quite obviously been drawn over toponyms and coastline, the writing of toponyms on the Becharius chart appear to have been written around the scale, indicating it was drawn first.[153]

Lepore et al. additionally argued that the chart was constructed around geographical points which had a measured latitude. The map only preceded the first translation of Ptolemy by Jacopo d'Angelo in 1406 by a few years, and Lepore et al. recognised Gautier Dalché's demonstration that Ptolemaic ideas had circulated in Europe earlier than the translation.[154] However, they ruled out the possibility that Becharius had been using original Ptolemaic information, as errors in Ptolemy's calculations were not apparent on the map.[155] Nonetheless, they did not theorise how Becharius gathered his supposed latitudinal information.

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150 Taylor, E. G. R.: *The Haven-Finding Art: A History of Navigation from Odysseus to Captain Cook* (London: Hollis & Carter, 1956). p. 90.

151 Prestage, Edgar: *The Portuguese Pioneers* (1933; repr. London: Adam & Charles Black, 1966). p. 316; See also: Taylor: (1956), pp. 158-160.

152 Lepore et al.: (2012), p. 17.

153 Ibid. pp. 21-22.

154 Ibid. p. 23. Also see: Gautier Dalché P.: *La Géographie de Ptolémée en Occident: IVe-XVIe siècle* (Turnhout, Belgium: Brepols, 2009).

155 Lepore et al.: (2012), p. 23.

The attribution of a remastered hydrography to a number of coastal locations with measured latitudes from across the Mediterranean, without documentary evidence, seems far-fetched. Moreover, while many Atlantic locations were latitudinally correct according to the scale, Mediterranean and Black Sea locations were not.[156] Given the similarities in the coastline between Dulceti's 1339 chart and Becharius' 1403 chart as shown above, it seems unlikely that Becharius redrew the established portolan chart hydrography from scientific measurements, and yet produced an incredibly similar littoral. Instead, it is far more likely that he copied a chart from the Dulceti lineage, simply readjusted Sardinia, and stretched the Atlantic northwards.

Figure 2.3.9: The latitude scale of the 1403 Becharius chart as it passes between the west coast of Ireland and the mythical island of 'Brasil'. Note the similarity of pigment colour and near-perfect positioning. Image courtesy of the Beinecke Library.

Nevertheless, that Becharius simply made qualitative adjustments to the established hydrography does not rule out the intriguing possibility that the latitude scale was contemporaneous, based on information from seafarers, which could have come from Genoese traders who were active in the Atlantic in the fourteenth century. From the digital facsimile, the inks and paints do seem to be similar, if not identical, colours. Additionally, the scale is well-positioned between Ireland and '*Insula de brasir*' at the north, and the toponyms of the Canaries and African coast in the south. This alone does not prove the scale was drawn first; whoever added it later may have simply been careful to draw it as unobstructingly as possible.

The theory proposed by Lepore et al. is intriguing and warrants further investigation. Becharius was interested in correcting the scale of the Atlantic, so perhaps he did search out astronomical information to include on his chart. Unfortunately, the Beinecke Library

[156] For example, Genoa was depicted at 46º30'N on the chart, but is in realty two degrees farther south. Alexandria was drawn at 35º30'N on the chart, but is 31º12' north in reality, and *Tana* (Tanais) on the Don river delta, was depicted at 59ºN on the chart, but is only 47º10'N in reality.

dismissed any possibility of archaeometric study of the map, fearing damage.[157] Although certain techniques, such as Raman Spectroscopy or Fourier Transform Infrared Spectroscopy, would identify the exact molecular composition of the pigments and dyes, they would require removing a sample from the map, permanently damaging it.[158] However, certain multi-spectral imaging techniques might be able to conclusively show that the rhumb lines are above the scale without risk: Professor Gregory Heyworth discussed a non-destructive multi-angular photographic technique that could depict one line of text or drawing clearly above another on a near-microscopic level.[159] Hopefully, the Beinecke Library will allow non-invasive analysis of the map in the future to determine if the Becharius chart really was the first map to depict a scale of latitude.

Ornamentation

In comparison with many other portolan charts, the 1403 portolan chart by Becharius was not extensively decorated, though his training as an artist is nevertheless apparent. Becharius did not include compass roses, which had first been depicted on the Catalan Atlas two decades prior, but did indicate the eight major winds with a painted encircled letter or symbol at the edge of each of the primary rhumbs: a motif popular amongst the earliest maps of the fourteenth century. No internal geographic features – orographic or hydrographic – were included on the map, except simple drawings of some rivers including the Rhône, Danube, and Nile. Ten city illustrations were drawn however, as well as four flags.

The ten urban illustrations that were drawn were labelled with the following toponymy (beginning in the North Atlantic, then following the Mediterranean coastline in a clockwise direction): '*Cologna*' (Cologne); '*Sanctus Jacobus de gallicia*' (the cathedral and pilgrimage site of Santiago de Compostela); '*Vignom*' (Avignon); '*Janua*' (Genoa); '*Venecia*' (Venice); '*Vecina*' on the Danube; '*damascha*' (Damascus); Jerusalem, which was labelled '*Civitas Ierusallem ubi est sanctum sepulcrum*'; '*Locha*' and '*Babilonia*' on the Nile; and '*tirimissem*' (modern Tlemcen in Algeria).

157 Lepore et al.: (2012), p. 21.

158 The archaeometry of manuscripts was the subject of my MA dissertation.

159 Heyworth, Gregory: *Beyond Mimesis: Digital Aesthetics and the Pre-Modern Text*, Lecture given to: University of Durham: Institute of Medieval and Early Modern Studies, 24 April 2012.

These places were either major centres of trade or held particular spiritual significance. The free city of Cologne, for example, was both an important trade centre and a place of great religious significance, and Tlemcen was the capital of the Berber Zayyanid dynasty and a major centre of trade. The now lost city of Vecina (alternatively Vicina), was an important Genoese trade centre, first depicted on the 1330 Dulceti chart.[160] Although Vecina was overtaken in importance by Licostomo (Kilia Vechia) in the mid-fourteenth century because it was a more navigable port and less prone to Bulgar interference,[161] Becharius choose to depict Vecina, and no other Genoese Black Sea colony. Venice was depicted as it is on most maps that include city illustrations, although considerably smaller than Genoa. This is unsurprising given the long history of hostility between the two city-states. Genoa, Becharius' home city, was by far the largest illustration he depicted, measuring 97 mm x 45 mm. Unlike the others, Genoa was drawn with the actual layout of the port in mind, including the lighthouse on the western cape, the old mole with its tower to the east, and the central square tower of the Doge's palace.

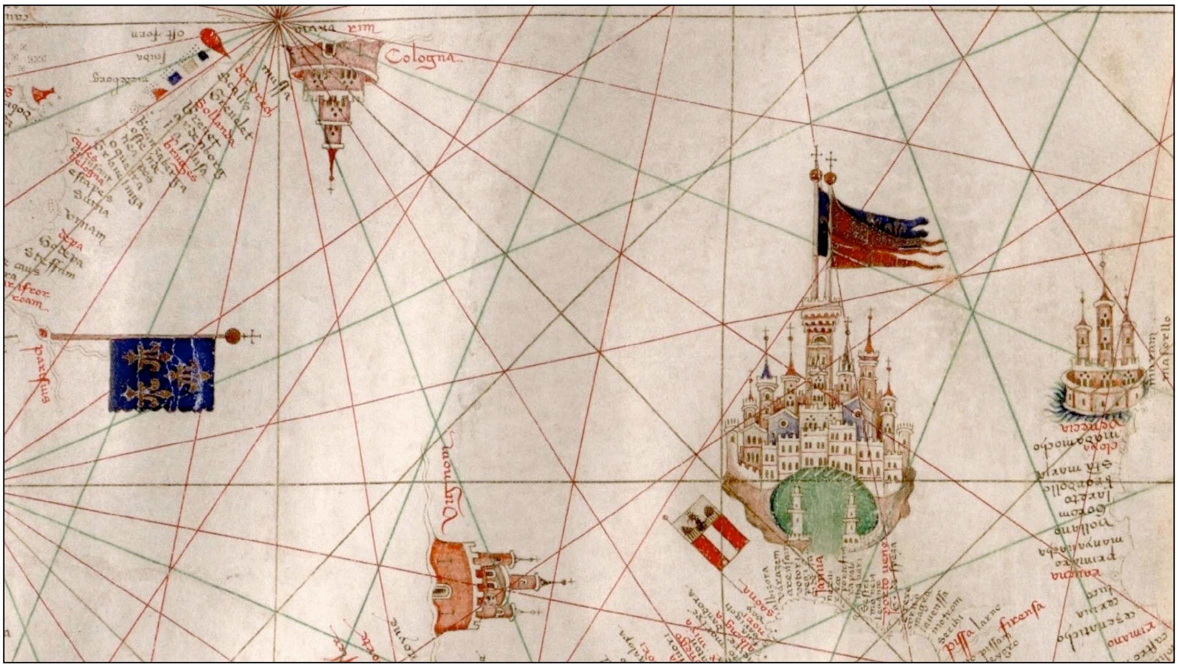

Figure 2.3.10: The cities of Cologne, Avignon, Genoa, and Venice, and the four flags of Paris, Savona, and Genoa appearing on the 1403 Franciscus Becharius chart. Image courtesy of the Beinecke Library.

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[160] Alexandru Madgearu discussed that the most probable theory is that Vicina was located about 1km south of Issacea, where aerial photography has revealed a buried street-grid. See: Madgearu, Alexandru: *Byzantine Military Organization on the Danube: 10th-12th Centuries* (Leiden: Koninklijke Brill NV, 2013). p. 136.

[161] Sedlar, Jean W.: *East Central Europe in the Middle Ages, 1000-1500*, History of East Central Europe, III (Seattle: University of Washington Press, 1994). p. 339.

Four flags were drawn on the map, which (of those that depicted them at all) is the lowest number of flags to appear on a portolan chart. These were, first, flying from the toponym '*parisius*' (Paris), which was not depicted with a city illustration: azure, three fleur-de-lis, one and two, Or; second, above '*Saona*' (Savona), which also was not depicted with an illustration: gules, a chief argent with an eagle sable, and a pale argent; and third and fourth, flying above Genoa, was the same Capetian/royal house of Valois flag that was depicted over Paris, and over it was the flag of St George: argent, a cross gules. The choice of these particular flags and no others indicates they had a specific meaning: in 1403, Genoa had been under French dominion since 1396, and Becharius was making a specific political statement that while Genoa was under French control, Savona was independent. Moreover, it would seem he was against French rule of his home city, given that he did not depict a city illustration for Paris, that the Genoese illustration was a massive 97mm by 45mm, and that the cross of St George nearly covers the French flag.[162]

While many decorated portolan maps depicted an extravagant number of different motifs, which filled in virtually every empty space on the map, the impression gleaned from the 1403 Becharius chart was that he specifically chose which decorations to paint, each with an apparent meaning. It could be said that the 1403 chart is the embodiment of the adage 'less is more': hundreds of embellishments – most copied from earlier maps – results in each retaining little meaning, whereas a few choice embellishments results in a map with a more clear statement.

Successors

The 1403 Becharius chart, and others presumably like it, became highly influential in in the genre of portolan cartography. The hydrographic changes made by Franciscus were copied by his son Batista, from whom two charts survive (dated 1426 and 1435) and to whom a further two are attributed. Batista's maps, in turn, were highly influential upon numerous chart-makers, including the prolific Petrus Roselli and Gratiosus Benincasa, both of whom adopted the updated hydrography. Roselli even included on his 1447 chart in Volterra: "Petrus Roselli composuit hanch cartam de arte baptiste becarii in ciuitate maioricarum anno domini m^{o} cccc^{o} xxxxvij", thus specifically informing the reader that his chart followed in the Becharius lineage. Benincasa alternatively adopted on all of his maps

[162] Sheehan: (2012), pp. 13-14.

the text Franciscus was the first to include on Ireland, referring to Galway bay: “Lacus fortunatus ubi sunt insule ccclxviii uocate insule sancte berite”. This brief text was a reference back to the lengthy description first seen on Dulceti’s 1339 map (discussed in that case study), which elucidated the marvels and miracles that could be witnessed on Ireland.

Figure 2.3.11: Ireland on the 1403 Franciscus Becharius chart. Note the numerous isles in the Bay of Galway, to which the text referred. Image courtesy of the Beinecke Library.

Conclusion

The survival of Franciscus Becharius’ 1403 portolan chart is fortunate because of his hydrographic alterations and his historically-invaluable explanation of those changes. Whereas nearly all portolan chart-makers simply copied their predecessors’ coastlines, Franciscus made the intelligent effort to change the status quo to be more correct. If the latitude scale was actually contemporaneous to the construction of the map, it would not only confirm Becharius’ ingenuity, but significantly alter historical knowledge about the development of maritime technology. Future non-destructive analysis could confirm this possibility, though it would be a mystery why the latitude scale then disappeared for another century (at least on surviving charts). Becharius’ maps were copied by his son Batista, and thoroughly disseminated into the genre, thus, one would expect that the scale would have been copied. For fifteenth-century navigation in the Atlantic, especially as mariners voyaged farther west to the Madieras and Azores, and southwards down the African coast, a latitude scale would have been a valuable inclusion. Its absence would indicate that its purpose, at least in the fifteenth century, was not utilitarian, but more academic. Of course, until it can be confirmed whether or not the scale was contemporaneous, this is merely hypothetical.

The Becharius chart, primarily because of the ‘address’, has been at the centre of the argument for portolan charts being utilitarian maps that were used for navigation. The logic behind this reasoning, discussed by Campbell and Pujades, is that Becharius had significant contact with sailors, who, in using other charts, had found they were problematic, and as a result, Becharius made alterations to make them more navigationally useful.[163] Although this reasoning is logical, it entirely relies on the assumption that Becharius only made the changes to make his maps more navigationally useful. It is equally possible that he made the changes for a more academic purpose: to create a more accurate depiction of the world for its own sake. Although the 'address' suggests navigational utility of maps, it is far from conclusive proof. As to the particular function of the 1403 chart, its large size, precise hydrography, and specific decorations indicate it was not an 'off-the-shelf' map, and certainly not one made to be used at sea, but one that was made for use as an exemplar from which other maps would be copied, or for a particular client who requested the specific inclusions, perhaps even the scale of latitude.

[163] Campbell: (1987), p. 428; Pujades i Bataller: (2007), p. 461.

The 1465 Chart of Petrus Roselli

Petrus Roselli

The Majorcan cartographer Petrus Roselli[164] was one of the most prolific chart-makers of the fifteenth century, second only to Gratiosus Benincasa in the number of his extant charts. Ten portolan maps were signed by him, and a further three are attributed, dating from 1447 to 1469. From the number of his surviving maps and his (minimum) twenty-two year period of production, it has generally been assumed that Roselli was a highly prolific chart-maker who produced a significant number of maps from his workshop in Palma. All of Roselli's maps were decorated, and his style evolved over time. Roselli's maps can be considered the archetype of the 'Majorcan School' of portolan cartography, and also perhaps its zenith: after about 1470, and certainly in the sixteenth century, Majorcan portolan cartography went into decline.[165]

Little is known about Roselli except what has been inferred from his cartographic output. Various scholars have argued about the nationality of Petrus Roselli. Heinrich Winter noted that early scholars such as Kretschmer and Magnaghi argued for Italian heritage for spurious reasons, including his linguistic style, that he followed the 'art of Batista Becharius', and even because of the sound of his name. However, de la Roncière identified numerous persons named Roselli in lists of converted Majorcan Jews between the twelfth and fourteenth centuries.[166] Winter concluded that Roselli, even if descended from an Italian family, must for all practical purposes be considered Catalan due to the nature of his maps,[167] which most modern scholars now accept. Pujades noted that his toponymy and texts were invariably Catalan, and that his script was a squat Gothic minuscule popular on Majorca at the time.[168]

The signature found on Roselli's earliest map from 1447[169] reads: "Petrus Roselli composuit hanch cartam de arte baptiste becarii in ciuitate maioricarum anno domini m^{o}

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[164] The name used throughout this work uses the spelling as it appeared on his signatures. However, other scholars have referred to Petrus Roselli as Pere Rossell.

[165] Astengo: (2007), p. 207.

[166] de la Roncière, Charles: *la Découverte de l'Afrique aux moyen âge: cartographes et explorateurs* (Cairo: l'Institut Français d'Archéologie Orientale pour la Sociéte Royale de Géographie d'Égypte, 1924-27). pp. 126, 128, as cited in: Winter, Heinrich: 'Petrus Roselli', *Imago Mundi*, 9 (1952), 1-11. p. 1.

[167] Ibid.

[168] Pujades i Bataller: (2007), p. 493.

[169] Volterra: Biblioteca Guarnacci, MS. CN1.

ccccº xxxxvij". This statement led to the theory that Roselli apprenticed under Batista Becharius. However, Winter concluded that there is no evidence that Roselli was a pupil of Batista, and his statement may have just been an acknowledgement of whose map he used as an exemplar.[170]

The Chart of 1465

Petrus Roselli's 1465 London chart must have once been an incredibly beautiful and expensive map, given the extent of decoration. Drawn on a single large parchment, it currently measures 61 cm x 80 cm, but was trimmed on all four sides at some point. If it had a neck (most Roselli maps did), it has been lost, along with Roselli's typical portrait of the Madonna. All the scale bars have also been lost because of trimming. It is surmisable that the map once measured roughly 70 cm by as much as 100 cm. Fortunately however, his signature, which was usually located on the neck, was not lost. It reads: "Petrus Roselli conposuit hanc cartam in ciuitate maiorcarum anno domini .M. cccc. lxv". The chart is in poor condition: the parchment is cracked, brittle and rather discoloured, the red and black inks have faded and the green ink has burned into the parchment and changed to a muddy brown. Unfortunately, the artifact history of the map is unknown, except that it was acquired by the British Museum in 1889.

Hydrography

The hydrography of the map includes the entire Mediterranean, Black Sea, Atlantic Europe as far as the south coast of the Baltic Sea, and Africa eleven toponyms past Cape Bojador to roughly 23º north. Atlantic islands typical of those depicted on Becharius charts were found, including the Canaries, Madeiras, and the Azores in their incorrect overly-eastern position and north-south orientation, typical of the Soler/Cresques-Becharius lineage. Had the map not been trimmed, one would expect the mythical islands of *Antillia* and *Salvaga* to appear on the chart. These large rectangular islands were first depicted on

[170] Winter noted the signature found on the Domenech map of 1486 (Greenwich: NMM, G230:1/9 MS) included the phrase "dizipulus petri Rossell", which was a much more clear (though by no means certain), acknowledgement that Arnaldus Domenech apprenticed under Roselli. See: Winter: (1952), p. 4.

Figure 2.4.1: The 1465 Petrus Roselli chart in London: British Library, MS. Egerton 2712. Image from: Pujades i Bataller (2007) DVD Supplement.

the 1424 chart in Minneapolis, believed to have been drawn by Zuane Pizzigano.[171] Although there was ample space for Roselli to depict them on his 1447 map in Volterra, *Antillia* and *Salvaga* first appeared on his 1464 chart in Nuremberg (figure 2.4.2), where corners from the two landmasses peek out from the border along the chart's neck. The islands were more clearly painted on the 1466 Minneapolis chart (figure 2.4.3), and even more so on his 1468 chart in New York.

Figure 2.4.2: The neck of Roselli's 1464 chart (Nuremberg: Germanisches Nationalmuseum, MS. La.4017). Image from: Pujades i Bataller (2007) DVD Supplement.

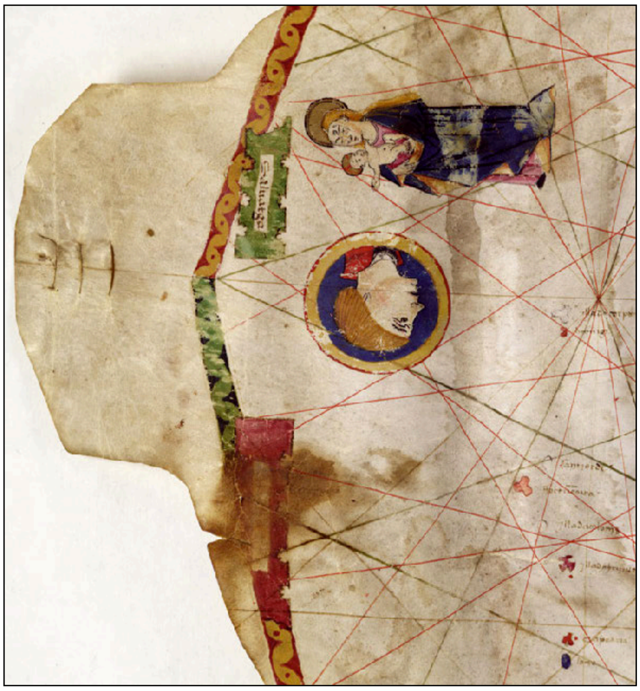

Figure 2.4.3: The neck of Petrus Roselli's 1466 chart in Minneapolis: JFBL, 1466 mRo. Image from: Pujades i Bataller (2007) DVD Supplement.

These islands, their mythological background, and hydrographic implications, are discussed in greater detail in Chapter IV. The islands were placed on several portolans until the early sixteenth century, and their existence was taken quite seriously by mariners and their patrons.[172]

The scale of Roselli's chart, according to Pujades' calculations, was 1.0 cm to 50 *miglia*.[173] This was his standard scale, used since 1462, at which five of his charts were created. This indicates (but is by no means proof) that he was copying his later maps from a

[171] Minneapolis: JFBL, 1424mPi.

[172] Between 1462 and 1487, Johnson identified eight unsuccessful Portuguese voyages taken to discover the islands. Johnson, Donald S.: *Phantom Islands of the Atlantic* (Fredericton, New Brunswick: Goose Lane, 1994). p. 95.

[173] Pujades i Bataller: (2007), pp. 205-206.

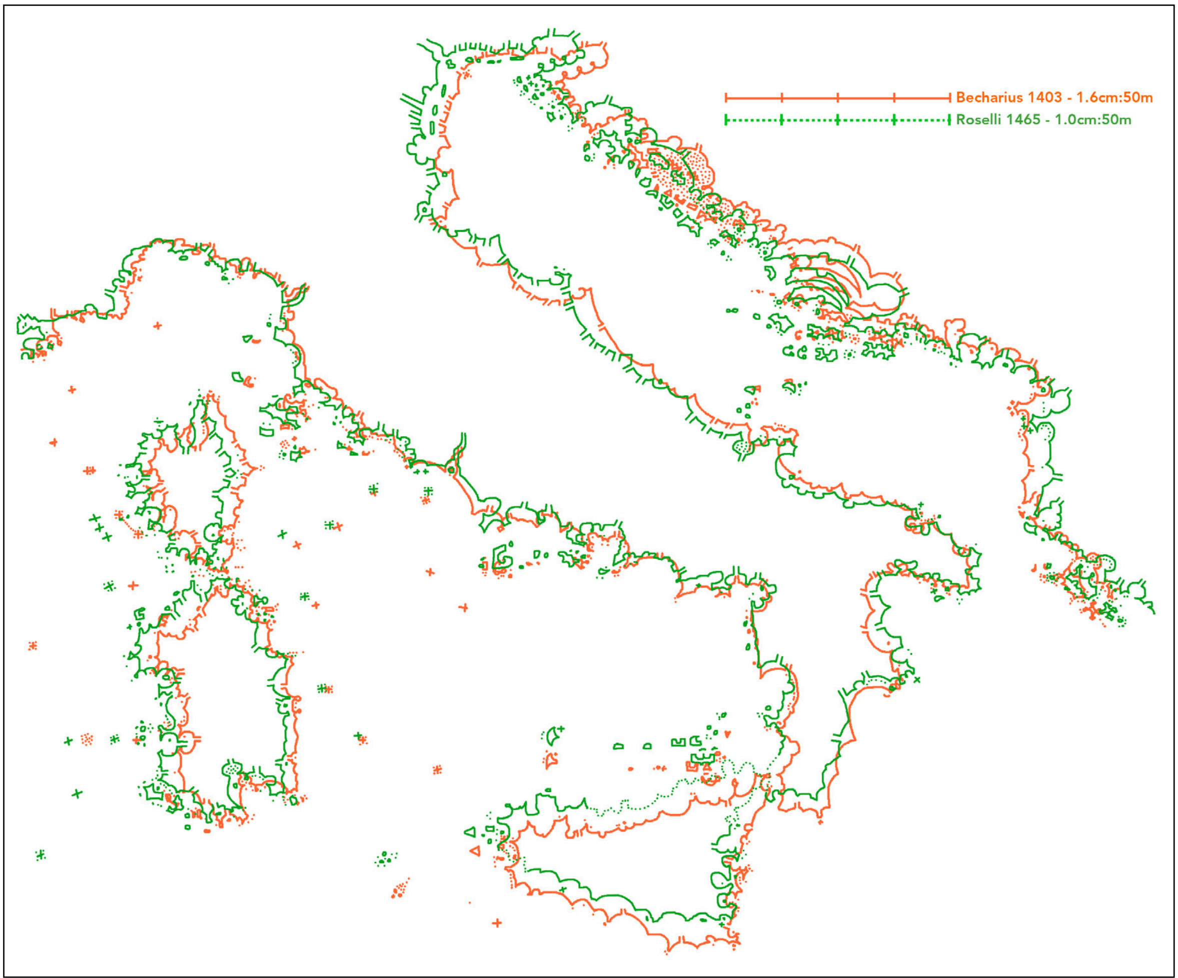

Figure 2.4.4: Superimposition of the coastlines of Italy from the 1403 Franciscus Becharius chart, and the 1465 Roselli chart. Digital tracings made using facsimile images from the Beinecke Library, and Pujades i Bataller (2007) DVD Supplement.

single exemplar source, at a 1:1 ratio. The two surviving Batista Becharius charts were drawn at a scale of 1.2cm : 50 *miglia*, and Roselli's first surviving chart was drawn at 1.1 cm. Although Pujades noted that his measurements were not perfect because of the warping of old parchment, it is not possible to determine an exact link based on scale measurements alone, but future cartometric study could indicate if Roselli used a single exemplar. Comparison of the hydrography of Italy between the 1403 Franciscus Becharius chart and Roselli's chart shows a good, albeit not identical, similarity. Comparison of the Atlantic however, shows quite clearly that Roselli did adopt Franciscus Becharius' northerly stretching of the coastlines, and even took it slightly farther.

Toponymy and Texts

The writing on the chart of 1465 is smaller than average, and Roselli seemingly did not hesitate to write as small as possible to fit every toponym on that he could.

Unfortunately, the poor condition of the map made transcription of many of the words difficult, which was additionally troubled by the near exact letter forms of 'r' and 'c'. Also interesting to note is Roselli's use of the round Italic 'd', which has lent weight to the theory that he was of Italian heritage, or trained under an Italian master. Equally possible however, was that Roselli simply mimicked the letter forms of his Batista Becharius exemplar, even if he had never met him, let alone trained in his atelier.

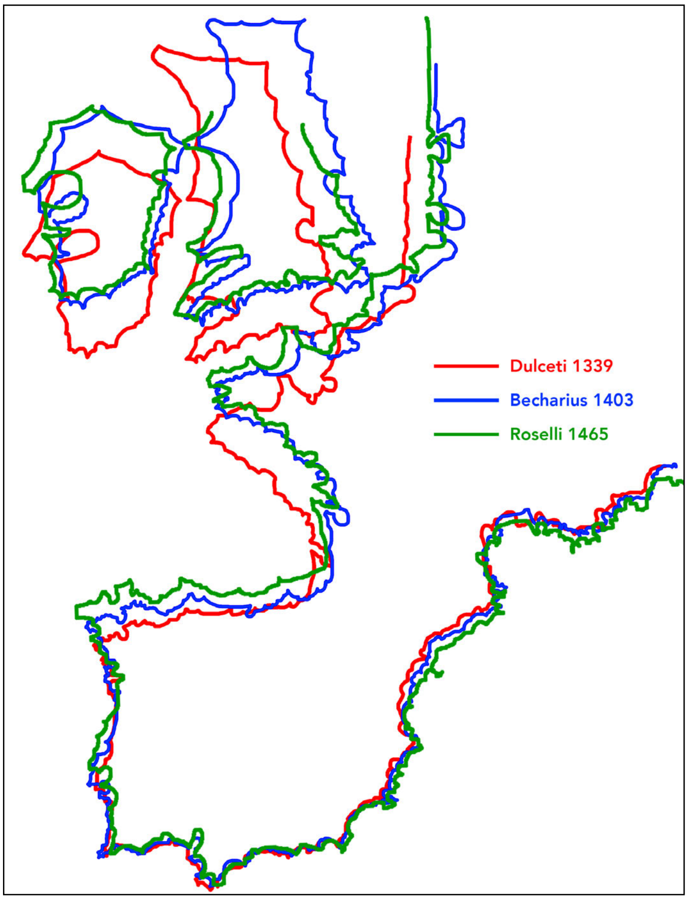

Figure 2.4.5: Superimposition of the coastlines of the western Mediterranean and Atlantic from the 1339 Dulceti chart, the 1403 Franciscus Becharius chart, and the 1465 Roselli chart. Digital tracings were made using facsimile images from the Bibliothèque Nationale, Beinecke Library, and Pujades i Bataller (2007) DVD Supplement.

Numerous expository texts were found on the 1465 chart. Most of these first appeared on the 1339 Angelino Dulceti map, and were quickly absorbed into the 'Majorcan School' of portolan cartography, appearing on most of the Cresques maps and others, including many of Roselli's maps. Though Dulceti's original legends were in Latin, by the c.1375 Catalan Atlas, they had been translated into Catalan, and most charts afterwards wrote the legends in the vernacular. Many of these legends have been transcribed,[174] and a few are discussed below.

Ornamentation

Despite the poor condition of the 1465 chart, it must have been rather grand when first made. Numerous internal features, such as mountains, rivers, and city vignettes, and decorations such as monarchs, expository texts, flags, and compass roses were added to the

[174] Winter: (1952), pp. 8-11; Sheehan: (2012), p. 19.

basic portolan cartographic elements. However, few, if any, of these inclusions were original to Roselli: most of them were copied from earlier Majorcan portolan charts, including those by Angelino Dulceti, as evidenced by his 1339 chart, the maps of Cresques, as evidenced through the Catalan Atlas, and those of Gabriel de Valseca, who was another prolific Majorcan chart-maker who operated a couple decades before Roselli.

Geographic Features

The Danube river appeared much the same on Roselli's map as on those of Dulceti, Cresques, and Valseca, with its three characteristic islands and numerous tributaries. The orography included the Atlas mountains, Sierra Nevada, and the Alps, all of which appeared in the same orientation and shape on Dulceti's 1339 chart: the Alps in a 'T' shape, and Atlas mountains as a snake across northern Africa with a single central jutting loop curving to the northeast, and three tails splitting off in the far east near Egypt. The only difference was colour: Roselli used light and dark greens, which, though presumably meant to be hills, appear like snake scales. A text below the Atlas mountains reads: "Aquesta montaya es apellada carena per serains e per crestians montis claris sapian que aquesta montaya a molta bona vila e castil los quals guerregen uns ablos alters aque sta montaya es abundade de tots bons del mond".[175] This text is similar to the one found on the 1339 Dulceti chart, and except for some spelling, is identical to one written on the 1439 Gabriel de Valseca chart.[176]

Roselli, like most Majorcan chart-makers, continued the tradition of painting the Red Sea red. A text nearby reads: "Aquesta mar es apellada la mar roga sapian que la mar no es roga mes lo fons es de quella color".[177] Similar texts appear on Dulceti's and Cresques' maps, and once again, this text is nearly identical to one found on the 1439 Valseca chart. Near Mount Sinai, which was decorated in the same green mountain colour as the Atlas mountains, and at the base of which was drawn the monastery of St Catherine, was the following text: "Mont de sinay in loquall deus dona la ley a [mo]ses en

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175 "This mountain range is called Carena by the Saracens and by the Christians the white mountains. Note that in these mountains are many good cities and castles which make war against the others. Note that in the said mountains there is an abundance of all goods of the world". See: Winter: (1952), p. 8.

176 Pujades i Bataller: (2009), p. 357.

177 "This sea is called the Red Sea. Know however that the sea is not red, but that the bottom is that colour".

loqualles […ma]dona Scā catalina”.[178] This text is quite similar to one found on Valseca, and also on the Catalan atlas.

Numerous city illustrations were drawn on the map, though mostly internally and not on the coast. The only exceptions were a large vignette of Genoa, and equally large illustration of Venice, both of which were also the only cities to bear resemblance to their actual appearance in reality. Genoa had been depicted realistically on portolan maps since the 1367 Pizigani chart, and Roselli's depiction appears quite similar to the one on the 1435 Batista Becharius chart, including the lighthouse, old mole, and even the small piers jutting into the bay.

Figure 2.4.6: Genoa and Venice depicted on Petrus Roselli's 1465 chart. Image from: Pujades i Bataller (2007) DVD Supplement.

Monarchs

Five monarchs were pictured on the map, each sitting inside a tent decorated with a thick blue pigment. The monarchs were labelled in illuminated gothic capitals, and are as follows: in Africa from west to east: King Mansa Musa ('*Rei Musamelli*'), the King of Organa (the title is completely illegible), the King of Nubia ('*Rei de [Nub]ias*'), and the Sultan of Babylon (Egypt: '*Solda de Babilonia*'); and in Anatolia, the Ottoman sultan, whose illuminated title is completely illegible, but who is referred to as the '*gran catamay*' in his descriptive text.

Many of these monarchs were copied from Roselli's predecessors; The legend next to the Sultan of Babylon reads: "Aquest es lo solda de babilonia lo qual es gran e poderos

[178] "Mount Sinai on which God gave the law to Moses and which is the mountain of the Madonna Saint Catherine".

senyor de tota sta pertida senyoraie tota egypta e la terra sancta fins al tauris",[179] which is virtually identical to the Valseca 1439 chart. Mansa Musa, King of Mali from c.1312 to 1337 was first depicted on Angelino Dulceti's portolan chart of 1339. The descriptive text on Roselli's chart reads: "Aquesta prouencia senyoraie aquest rey apellat musa [m]elli, senyor de [Gu]eniá [es] rich e pus poderos senyor de tota sta partida per l'abundancia de l'or ques [ra]cull en la sua terra."[180] This text is nearly identical to the legends found on the Catalan Atlas, and on the 1439 Valseca chart.

Figure 2.4.7: Depiction of Mansa Musa on the 1465 Petrus Roselli chart. Image from: Pujades i Bataller (2007) DVD Supplement.

While Dulceti, who first referred to King Musa I on his 1339 chart, did so because he was an actual monarch at the time,[181] other maps continued to refer to Musa I specifically, rather than writing a more general title such as '*Rex Melli*', up to 150 years after his death. Prester John, who may never have actually existed, was also very often included on the maps (though not on Roselli's 1465 chart). The conscious inclusion of legendary figures,

[179] "This is the Sultan of Babilonia who is the great and powerful ruler of this entire region, who reigns over all of Egypt and the Holy land as far as the Taurus (Mountains)".

[180] "Over this province reigns this king, called Musa Melli, Lord of Guinea [and] Ethiopia. [He] is wealthy and the most powerful ruler of this entire region through the abundance of gold that is gathered in his land."

[181] Mansa Musa had died only two years previously, of which Dulceti might not have been aware.

rather than living ones, suggests either that the chart-makers at this time were unaware, and blindly copying earlier maps, or were more interested in making maps with a scholarly and historical function. Both scenarios do not indicate a utilitarian function.

The only original monarch, not derived from either the Catalan Atlas or Gabriel de Valseca's maps, was the Turkish Sultan: "Aquest es lo gran catamay lo quall guarega ab los | Grechs e [c]hrestes".[182] Although Winter believed that the final nearly illegible word was '*prestres*' (priests), it appears in facsimile to be '*chrestes*'.[183] Although many other Majorcan charts did include an illustration of the Turkish monarch, this text could not be identified on any earlier map. At the time of the map's construction, Mehmed II had secured Anatolia, conquered Constantinople, most of Greece and Serbia, and was engaged in war with the Venetians, news of which had undoubtedly reached Majorca.

Vexillography

A total of sixty-eight flags appear on Roselli's chart of 1465, not only above cities, but above the monarchs' tents, and directly on islands, including Lanzerote (cross of St George), Rhodes with the cross of the Knights Hospitaller, and Majorca with the arms of the crown of Aragon (Or, four pallets gules). Moreover, Sardinia included a shield with the arms of the Crown of Aragon, and Sicily a shield with the arms of its kingdom under Aragonese rule.[184]

The flags depicted around the eastern Mediterranean and Black Seas did not accurately represent sovereignty. Roselli choose to depict '*Salonicha*' (Thessaloniki), '*castelles*' (Cide), and Constantinople all flying the Byzantine flag of the Palaiologos dynasty (gules, a cross Or, quarterly four letters beta Or), despite the fact they were conquered many years before: Thessaloniki in 1430 by Murad II, and Constantinople in 1453 by Mehmed II.[185] Genoese flags, gilded with silver (which has now tarnished to black), were flown above their Black Sea entrepôts of Pera (across the Golden Horn from Constantinople), Caffa on the Sea of Azov, and '*Simisso*' (modern Samsun). Yet, only Caffa

[182] "This is the great Catamay, who fights against the Greeks and Christians".

[183] Pujades i Bataller: (2007) DVD Supplement.

[184] A combination of the red and gold stripes of Aragon and the eagle of Hohenstaufen: per saltire quarterly, first and fourth Or, four pallets gules per fess, second and third argent, an eagle sable displayed.

[185] Sheehan: (2012), p. 19.

was still in Genoese control. On the south coast of Anatolia, the ancient city of Corycos (written '*cruco*', modern Kizkalesi), which fell to the Turks in the late fourteenth century, was depicted with its independent flag (azure, ten crosses argent), and similarly, '*Satallice*' (modern Antalya) was depicted with its arms, presumably of the Beylik state of Teke for which it was the capital, despite being conquered by the Ottomans in 1423. Although it has been theorised that these inaccurate flags were an active denial of the reality of the Turkish conquests in the east,[186] another possibility is simply that Roselli, like many other chart-makers before and after, copied the flags depicted on earlier maps without question. With the exception of Corycos, the aforementioned flags Roselli depicted on his 1465 chart were nearly identical to those found on Valseca's 1439 chart.

Contrastingly, but not unexpectedly, places which were major trading centres for the Aragonese were depicted more accurately, including: Nice, which displayed the arms of the Counts of Savoy (gules, a cross argent); Avignon, depicted with its standard arms since the fourth Avignon Papacy of Clement VI from 1342 to 1352 (gules, three keys Or placed in fess); Montpellier, which had been under the Crown until 1349 (per pale azure, and argent with a roundel gules);[187] Narbonne (azure (or argent?), a cross and four triangles quarterly gules);[188] Barcelona (quarterly, first and fourth Or two pallets gules per fess, second and third argent a cross gules), and Valencia (per pale azure and Or with four pallets per fess gules) amongst others. These flags were again, nearly identical to those depicted on the 1439 Valseca chart.

The impression gleaned from Roselli's depiction of flags was that individual cities' flags were painted, not those of their suzerains. The Crown of Aragon, for instance, was formed of many polities – the Kingdom of Valencia, the County of Barcelona, the Kingdom of Majorca, Sicily, Naples, etc. – and it was the individual polities' flags that were drawn. For those places that had been conquered by the Ottomans, the retention of the former flag was perhaps a conscious denial, or an acknowledgement of the true cultural identity of each place rather than their political overlords, or merely oversight. Nearly every other portolan chart-maker did the same.

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[186] Campbell: (1987), p. 399; Sheehan: (2012), pp. 19-20.

[187] This flag was heavily degraded, so it is difficult to be certain of its blazon.

[188] Due to significant degradation of the pigment, it is not possible to say whether this was blue, or tarnished silver.

Conclusion

Roselli was a prolific chart-maker, and it could be argued that he was the last of the great Majorcan portolan cartographers, which began with Angelino Dulceti in the first quarter of the fourteenth century, and included the Cresques and Valseca ateliers. It has been argued that Roselli, despite his considerable cartographic output, was merely a copyist, duplicating the content and style of former portolan cartographers.[189] On his first chart, Roselli credited Batista Becharius, indicating perhaps even that he was Becharius' apprentice, and evidence suggests that the chart of 1465 was copied (at least in stylistic content), from the maps of Gabriel de Valseca. Roselli's flags, monarchs, and texts all appear to have been duplicated almost without alteration from his map of 1439, or one similar to it.

However, with the notable exception of Franciscus Becharius' chart of 1403, nearly all portolan charts since their initial dissemination and proliferation by Dulceti and Vesconte, were copies, repetitious of earlier content without alteration. Petrus Roselli was operating in the same conservative manner as his predecessors. Roselli's minimum twenty-year career as a skilled chart-maker, and his number of extant maps, indicates that he was a career cartographer, unlike some who operated part-time.[190] His charts were seemingly based on Valseca's work (those from 1464 in Nuremberg, 1465 in London, 1466 in Minneapolis, and 1468 in New York), and were so heavily decorated that they would have taken a minimum of a few months each to make. Each might have earned him between ten and twenty Majorcan pounds,[191] and there must have been a significant demand for them. The pattern of uncritical duplication by Roselli and many others is not indicative of utilitarian function, and certainly the value of these maps suggests a function other than navigation.

[189] Ibid. p. 20.

[190] Some chart-makers only made maps part-time, such as Andrea Benincasa and Antonio Pelechan. See Chapter III.

[191] For a discussion of the prices paid for portolan charts, see Chapter III.

The 1468 Atlas of Gratiosus Benincasa

Gratiosus Benincasa (also known as Grazioso) was one of the most prolific cartographers in the fifteenth-century. Campbell identified six signed portolan charts, seventeen signed atlases, and a further two attributions, making Benincasa the most well-represented portolan cartographer prior to 1500, and one of the most prolific of all.[192] The son of Jacopo and the Countess Casciotti, Gratiosus was probably born at Montesicuro in Ancona in the first quarter of the fifteenth century.[193] A minor noble, Benincasa fathered five sons with his second wife, Pollonia Bonagiunta Bonarelli.[194] With his first wife – Franca di Antonio di Torello Petrenghi – Gratiosus Benincasa fathered one son, Andrea, who became a cartographer of portolan charts.

According to Campbell, Benincasa had been a '*padrone*' (ship owner or captain) in the years prior to his cartographic undertakings.[195] During his travels between 1435 and 1445, Benincasa compiled a *portolano*, comprising his notes of distances and directions and useful information learnt while sailing.[196] This 'pilot's log' did not contain any drawn maps however,[197] and there is no evidence to suggest Benincasa used or created maps until the 1460s. As revealed by documents dating to 1460-1461, the loss of his ship to a Genoese corsair ended his career as a captain, and it was during the legal proceedings in Genoa that Benincasa created the first two of his extant nautical maps, both provenanced to 1461 in Genoa.[198] By 1463, Benincasa was back in Venice, and from the number of portolan maps he produced, it would appear he had become a full-time cartographer. The majority of his maps were created in Venice, though Benincasa was in Rome in 1467 (known from three signed, dated, and provenanced atlases), and was periodically active in Ancona, his home city, in 1470 and 1480-82.

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192 Campbell, Tony: 'Census of Pre-Sixteenth Century Portolan Charts', *Imago Mundi*, 38 (1986), 67-94.

193 The first document to record Gratiosus Benincasa dates to 1430; See: Codazzi, Angela: 'Benincasa, Grazioso', Dizionario Biografico degli Italiani, vol. 8, (1966) <http://www.treccani.it/enciclopedia/grazioso-benincasa_(Dizionario-Biografico)/> [accessed 18 April 2012].

194 One of his sons – Antonio – became an important diplomat to the Papal and French courts, and another son was bishop of Ancona-Osimo from 1484 to 1502.

195 Campbell: (1987), pp. 433-434.

196 This portolano is preserved in the Municipal Archive of Ancona.

197 Ibid. pp. 433, note 430.

198 Ibid. p. 433 (note 429). These two charts are CN5 and CN6 in the Archivo di Stato, Florence.

The 1468 London Atlas

Benincasa authored two atlases and one chart that have reached us from the year 1468. The chart[199] and one of the atlases[200] were signed in Venice, yet the other atlas is curiously without provenance.[201] It has mistakenly been thought to have been made in Genoa, but this is incorrect; Emiliani posited there is no evidence that Benincasa was ever in Genoa after 1461, and the other two of that year were made in Venice.[202] This non-provenanced London atlas is the subject of this case study. The signature on folio 5r (plate 3) states the following: "Gratiosus de be[nincasa] Anchonitanus Magister viro prospero camulio Medici Genuensis | fecit 1468."[203] Former scholars incorrectly translated 'medić' as a 'physician', but this signature actually refers to the papal clerk Prosper Camulius de Medici of Genoa. Register documents from the papacy of Sixtus IV (1471-1484) indicate that Camulius was later a papal collector and nuncio in Ireland, England, and Scotland from 1474 if not earlier,[204] and from 1478 was Bishop (elect) of Caithness.[205]

Figure 2.5.1: Benincasa's signature from his 1468 atlas in London: BL, Add. MS. 6390, f. 4v. Image from: Pujades i Bataller (2007) DVD Supplement.

Whether the atlas was 'off-the-shelf', or commissioned by Prosper Camulius is unknown. The signature could have been added after the purchaser had been found.

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[199] In the collection of the Fundación Bartolomé March Servera, Palma de Majorca.

[200] In private collection. See: Campbell: (1987), p. 450.

[201] London: BL, Add. MS. 6390.

[202] Caraci, Giuseppe: 'An Unknown Nautical Chart of Grazioso Benincasa, 1468', *Imago Mundi*, 7 (1950), 18-31. p. 19.

[203] "Gratiosus Benincasa of Ancona, for the noble master Prosper Camulius de Medici of Genoa, made [this map] in 1468". Interestingly, from the 'r' of Gratiosus through 'camulio', there is a deliberate obscuration of the text with the appearance of staining, as though chemically damaged. This is likely why the identity of the owner has previously gone unnoticed.

[204] Vatican Regesta 656: 1471-1476, Calendar of Papal Registers Relating to Great Britain and Ireland, Volume 13: 1471-1484, J. A. Twemlow (editor), in British History Online, http://www.british-history.ac.uk/report.aspx?compid=105059 (accessed 18 April 2012).

[205] Lateran Regesta 779: 1477-1478, Calendar of Papal Registers Relating to Great Britain and Ireland, Volume 13: 1471-1484, J. A. Twemlow (editor), in British History Online, http://www.british-history.ac.uk/report.aspx?compid=105151 (accessed 18 April 2012).

Furthermore (and discussed in greater detail below), the illustration of Genoa suggests it was an unplanned addition to the atlas, indicating the atlas was produced before the illustration was added.

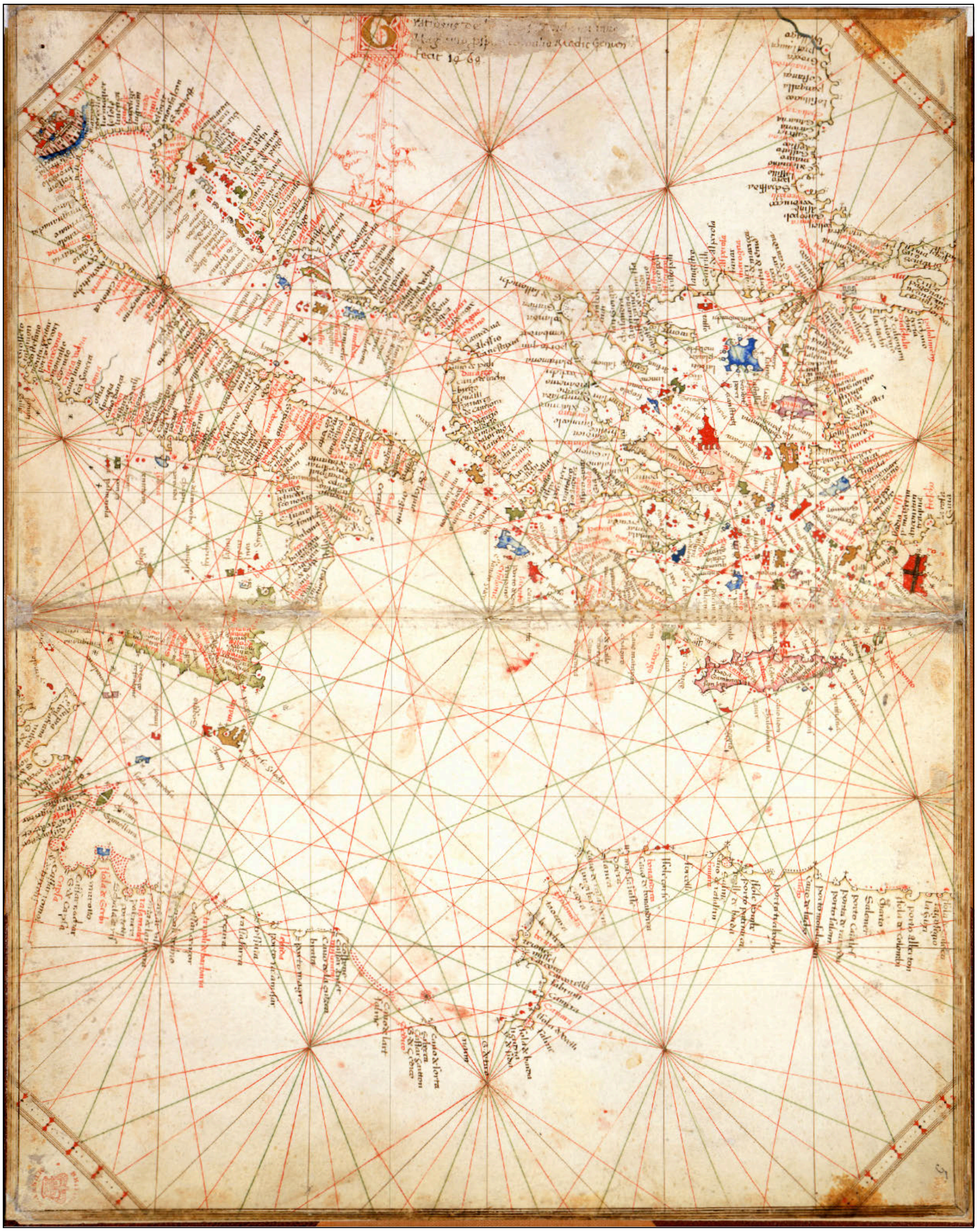

Figure 2.5.2: Folios 4v and 5r from the 1468 Gratiosus Benincasa atlas in London: BL, Add. MS. 6390. Image from: Pujades i Bataller (2007) DVD Supplement.

The 1468 atlas by Gratiosus Benincasa measures 345 mm wide by 273 mm tall and is constructed of nine folios including six nautical maps. The atlas was rebound at some point in the recent past; the maps are currently mounted flat on the recto side of each folio, but in the past, the atlas was half the width and the maps ran from verso to recto, bound through the centre. Unlike a codex, there would have been wooden boards between each folio, and only the flesh side of the parchment was used. The penciled foliation numbers reflect the earlier binding (i.e. the map that was ff. 3v-4r is now only the third folio recto, with nothing on the verso side). To ease in confusion, this study will refer to the modern bound arrangement as 'plates' and the earlier binding as 'folios' in the traditional sense.

The Calendar

On the first plate (ff. 1v and 3r)[206] is a calendar of twelve tables, one for each month, and on each table the nineteen-year metonic lunar cycle from 1451 to 1469 was written: these listed the day(s) ('*dies*'), hour(s) ('*ore*') and points ('*ponti*') for each. A text at the bottom explains the table: "Questa sie la tavola da face quando fa la luna et comincia ala casa del •1451• Et finisse come segiuta: Et quando e compita ritorna da cauo edirai •1470• et trouarala giusta."[207] On f. 3r below the lunar calendar was a more simple Paschal date table, listing the year, month and date for Easter from 1432 to 1531. This table was explained with the following text; "Questa sie la tavola da fauere quando uien la pasqua Et comincia ala casa del •1432• et finisse come segiuta Et poi ritorna da cauo edirai •1532."[208]

The inclusion of lunar and Easter calendars in portolan atlases was a common occurrence: atlases of Petrus and Perinus Vesconte included elaborate and sumptuously-decorated wheel calendars, as did the Catalan atlas, and the anonymous Medici and Pinelli-Walckenaer atlases. Campbell discussed the use (and misuse) of these calendars to date undated portolan atlases, concluding that there is never certainty that the earliest date in the calendar is the date of the atlas' construction.[209]

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[206] The second folio (foliated with the atlas) is a handwritten note in Italian, dating to the late-nineteenth or early-twentieth century, which compared the 1468 atlas to one from 1469, which is: London: BL, Add. MS. 31315.

[207] "This is the table made of when the moon is full and begins its phase from 1451. And it finishes as it ensued: and when it is complete return back again and you will go [from] 1470, and find it is right".

[208] "This is the table made for when Easter comes, and begins at the [moon] phase from 1432, and finishes as it ensued: and then return back again and you will go [from] 1532".

[209] Campbell: (1987), pp. 446-448.

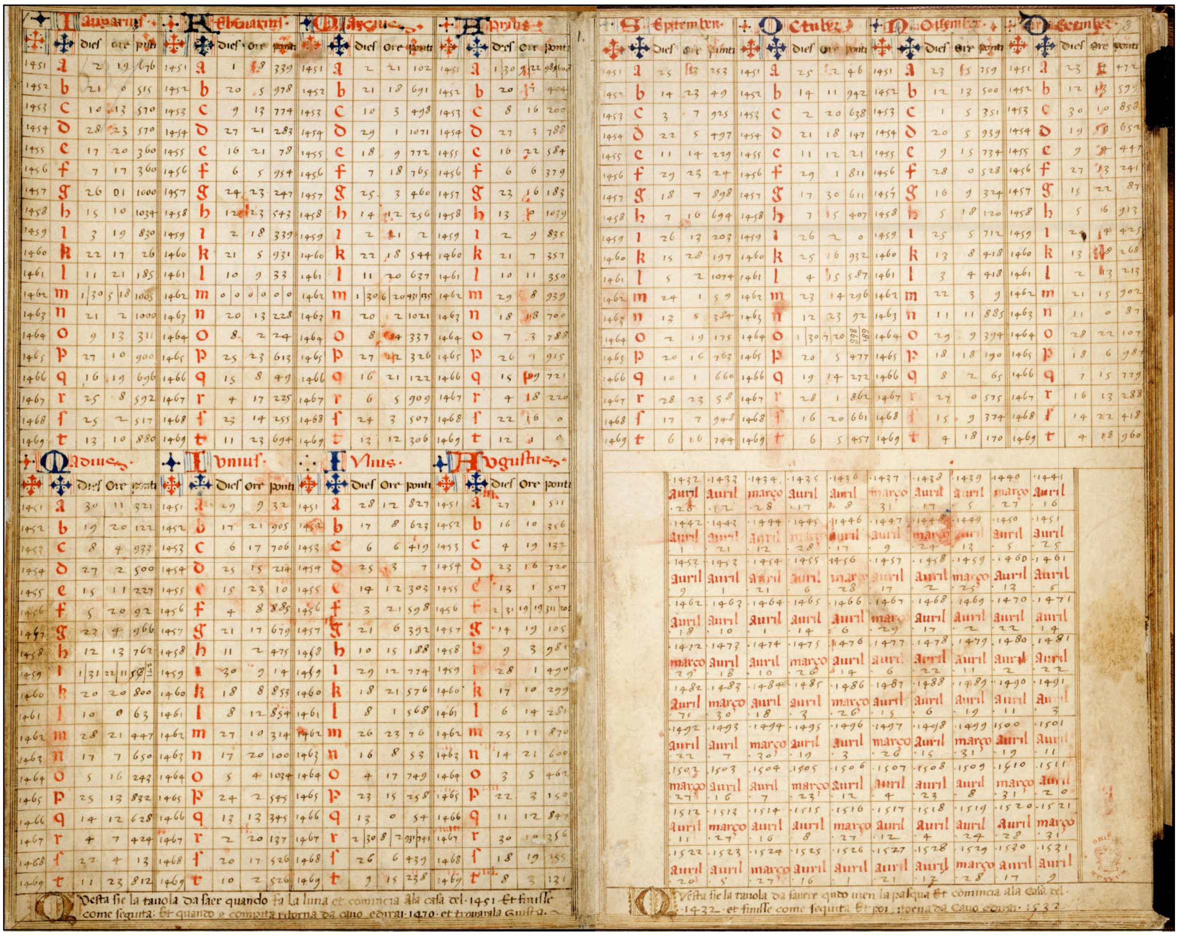

Figure 2.5.3: Folios 1v and 3r from the 1468 Gratiosus Benincasa atlas, showing the lunar table and Easter calendar. Image from: Pujades i Bataller (2007) DVD Supplement.

Before the advent of portolan charts, maps were often included with *computus* manuscripts, usually T-O diagrams or small *mappaemundi*. Notable examples include the Anglo-Saxon map,[210] manuscript no. 17 at St John's College Oxford, and the Ripoll manuscript,[211] all of which were discussed by Edson in her book 'Mapping Time and Space'.[212] Edson discussed the relationship between maps and *computus*, and concluded medieval and Renaissance scholars considered both geography and time as interrelated components of God's creation.[213] Thus, there is little reason to question the presence of calendars within atlases. However, they indicate a more encyclopaedic and academic function, rather than navigational utility. Prosper Camulius, as a Papal nuncio, would have had good reason to desire a lunar and Easter calendar in his atlas.

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210 London: BL, Cotton MS, Tiberius B.V, f. 56v.

211 Rome: BAV, MS. Reg. Lat. 123.

212 Edson, Evelyn: *Mapping Time and Space: How Medieval Mapmakers Viewed Their World* (London: The British Library, 1997). pp. 72-96.

213 Ibid. p. 96.

Hydrography

The atlas is rather typical in its hydrographic content, and depicts the coastlines of the Black Sea, Mediterranean, and Atlantic European and African littoral. The first map (ff. 3v-4r) included the Black Sea and eastern Mediterranean, but had a discontinuous coast: most of the Aegean sea was missing, and the Black Sea was shifted westwards to fit in the space available; this unusual hydrographic displacement was not uncommon for portolan atlases, which had more limited space for mapping than charts, and Benincasa included the Aegean in a later map.

Figure 2.5.4: Ireland depicted on the 1468 Gratiosus Benincasa atlas, with its unfinished inscription. Image from: Pujades i Bataller (2007) DVD Supplement.

Folios 6v-7r incorporated northwest Europe from southern Portugal to Denmark (‘*dacia*’), including the British Isles (which were displayed in their usual manner for Benincasa),[214] and the common mythical isles of the north Atlantic: ‘*Isola de braçil*’[215] and ‘*Isola demar*’. Unusually for Benincasa, his habitual text in Ireland was unfinished despite ample space, and only included: “Lacus fortunatus ubi sunt insule”. On nearly all of his other maps the text continued: “quae dicuntur Insule sancte beate •ccclxvii•”.[216] This text was written next to a much enlarged Galway Bay on the west coast of Ireland, colourfully dotted with numerous islands. The motif originated with Franciscus Becharius on his 1403 chart,[217] and Benincasa copied it from Batista

[214] For more on the style of Benincasa and attributing anonymous works to him, see: Campbell, Tony: 'The style and content of Grazioso Benincasa's charts: imitation, innovation and repetition', (2009) <http://www.maphistory.info/benincasa.html> [accessed 19 January 2010].

[215] The island of ‘brasil’ derives from the Dutch ‘hy bressail’ meaning ‘happy isle’ and was a part of the St. Brendan hagiographical tradition. See: Delumeau, John: *History of Paradise: The Garden of Eden in Myth & Tradition*, trans. by Matthew O'Connell (New York: Continuum, 1995). pp. 104-105.

[216] “The prosperous waters where there are 367 islands that are called the Holy Blessed Isles”.

[217] As discussed in his case study, Franciscus derived the text (presumably) from the Majorcan charts that had often described the magical marvels of Ireland, beginning with Angelino Dulceti in 1339.

Becharius.[218] Why the text went unfinished on the 1468 atlas is unknown: there is no indication of erasure, and there was plenty of space to include the additional lines.

The atlas included a typical set of Atlantic islands: the Madeiras and Canaries, and the Azores, which had been drawn too far east and oriented north-south instead of east-west, as they had been depicted since the c.1375 Catalan Atlas. As was standard, the islands were labelled the '*Insule fortunate Sancti brandani*', echoing Pliny's description of them in his *Natural History*.

The seventh map in the atlas (ff. 8v-9r) was not typical for any previous chart-maker. Benincasa continued the African coast southwards from the usual extent of portolan maps – Cape Bojador – to '*cauo mesurado*' (near Monrovia, Liberia). Portuguese explorers captained by Pedro de Sintra first reached this point in 1462,[219] and Gratiosus is credited as being the first known cartographer to depict Africa this far south.[220] It is debatable how Benincasa acquired the hydrographic and toponymic information. It is generally believed that the Portuguese had a strong tradition of portolan mapmaking, though the earliest extant Portuguese portolan map is the 1492 Jorge de Aguiar chart.[221] Benincasa might have had access to a lost Portuguese map. Alternatively, Campbell discussed how the most southern extremes were often depicted nonchalantly in Benincasa atlases,[222] which suggests Gratiosus believed precision was unnecessary because those mapped areas would not have been navigated by the users of his maps. Instead, his inclusion of the farthest extent of human discovery would have been more to celebrate the advancement of maritime advancement.

Comparison of the Italian coastline between Benincasa's 1468 atlas and Becharius' 1403 chart shows a moderate similarity: Gratiosus moved Sardinia northwards following Becharius' more correct positioning. Although more hydrographic comparison would be necessary for confirmation, it is certainly probable that Benincasa's initial exemplar was derived from a Genoese map, rather than a Venetian one, given the hydrographic similarity, his adoption of Becharius' '*Lacus Fortunatus*' motif on Ireland, and other aspects.

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218 Campbell: (2009). Benincasa always wrote that there were 367 islands, whereas Becharius wrote there were 368.

219 Prestage: (1966), pp. 180-184.

220 Campbell: (2009). Campbell posited that Petrus Roselli may have obtained the coastal information before Benincasa, but as a maker of charts rather than atlases, had no way of extending the size of his maps to incorporate the information.

221 New Haven: BRBML, 30cea/1492.

222 Ibid.

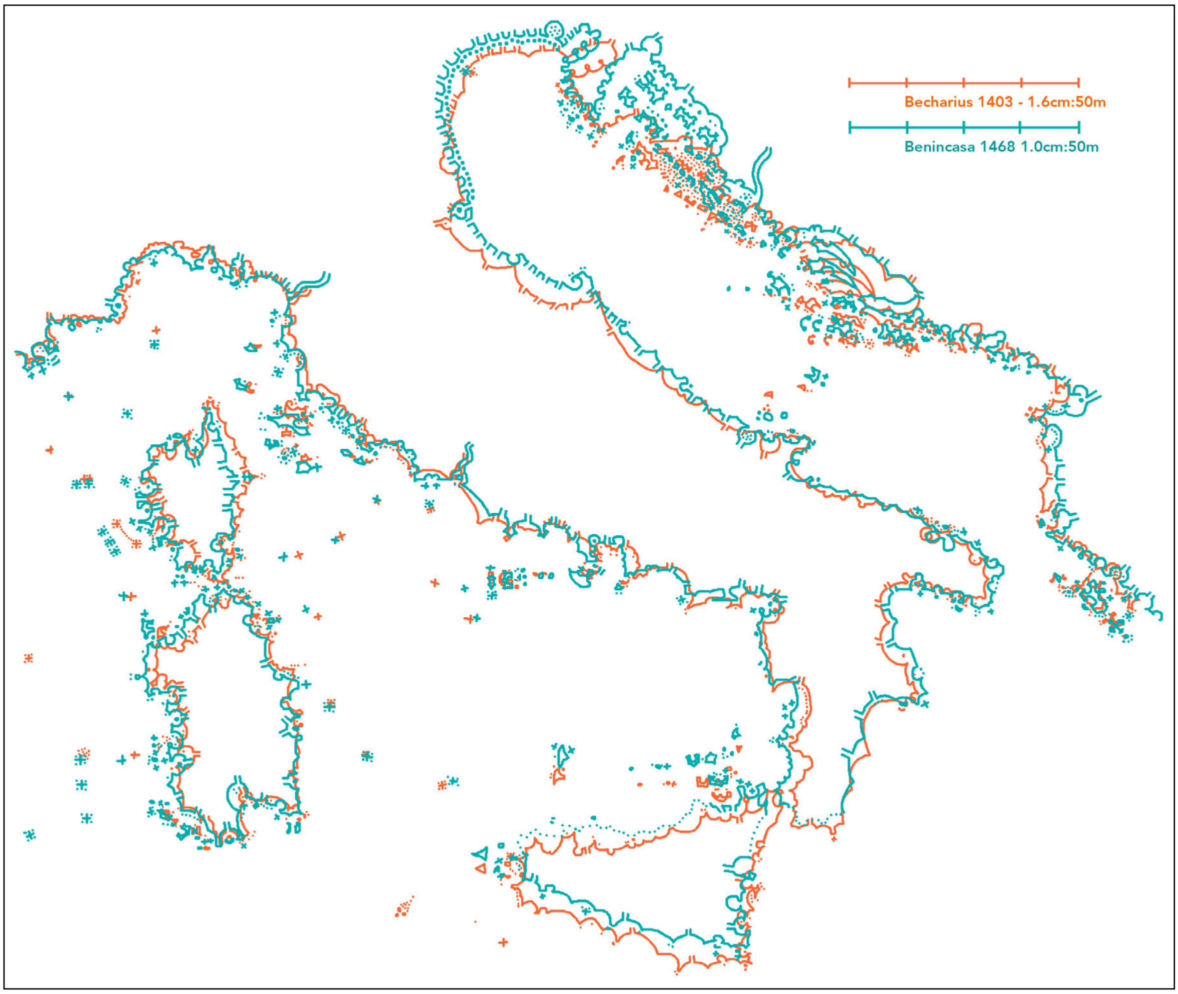

Figure 2.5.5: Superimposition of the coastlines of Italy on the 1468 Benincasa atlas, and the 1403 Becharius chart. Digital tracings made from images from: Pujades i Bataller (2007) DVD Supplement, and the Beinecke Rare Book and Manuscript Library.

Though similar to Becharius, Benincasa significantly altered the littoral of the Kvarner Bay in the northeastern Adriatic from his earliest chart of 1461, adopting a much deeper shape more commonly found on Venetian charts, which was not done by either Franciscus or Batista Becharius. One reason might have been to make more space to better depict the numerous islands in the area, or alternatively, the chart Benincasa first copied might have featured the same littoral, and is not a map that can now be identified.

Benincasa commonly used diagonal scale bars placed in each of the four corners for his atlases, and the 1468 London atlas is no exception. The scale used consistently throughout the atlas was a rather small 1.0 cm to 50 *miglia*. A compilation of measurements from seventeen maps demonstrated that Benincasa most often used two scales, and a third once: the smallest – 1.0 cm : 50 m – was mostly used for his charts, an atlas from 1463 and this 1468 atlas. The scale of 1.3 cm : 50 m was used for the rest of his atlases, and was the most common one he used. Finally, Benincasa's chart of the Atlantic, made in 1468, was drawn at a large 1.6 cm : 50 m.[223] The fact that the 1468 atlas was drawn in a smaller scale additionally indicates that its purpose was not navigational, because a large scale would have been necessary for ship-board position calculations.[224]

Toponymy

The palaeography on the 1468 atlas is quintessentially the hand of Benincasa: a clear and legible humanist minuscule with Italian characteristics, such as the rounded 'd'. It would appear that throughout this atlas, Benincasa wrote the black toponyms before the red toponyms, as demonstrated by several examples of red toponyms squeezed into spaces too small for them. Benincasa also wrote smaller, when necessary, to fit all the toponyms in he wanted, or from the exemplar he copied. Comparison of the toponyms with two other of Benincasa's works[225] revealed little difference in the spelling, order and density of place-names around the littoral, which suggests Benincasa copied consistently from the same exemplar. However, someone, in a hand and ink different from Benincasa's, labelled eight western European rivers throughout the atlas: '*sequena*' (Somme), '*dorius*' (Duoro), '*tagus*' (Tagus), '*getis*' (Guadalquivir), '*staberis*' (Segura), '*iber*' (Ebro), '*todanus*' (Rhône), and '*renus*' (Rhine).[226]

Ornamentation

Like most of Benincasa's maps, the parchment of the 1468 atlas was a high-quality vellum. The black ink is dark and crisp (thus likely iron gall ink), and the red and green pigment inks have not degraded or 'burned' significantly. The atlas used a blue pigment for islands and rivers, and a variety of coloured dye washes to highlight the coastlines. A modest amount of gold leaf was applied throughout the atlas, specifically on the island of Majorca, and a few of the larger islands in the eastern Adriatic. A powdered silver paint

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223 Scale information found in: Campbell, Tony: 'Tables accompanying the online note: 'The style and content of Grazioso Benincasa's charts: immitation, innovation and repetition", (2011) <http://www.maphistory.info/BenincasaTables.doc> [accessed 1 May 2012] ; Pujades i Bataller: (2007), pp. 204-209.

224 The problem of the small scale of portolan charts is discussed in greater detail in Chapter IV.

225 Toponyms were compared with: Benincasa, Gratiosus (8 October 1470): London: BL, Add. MS. 31318.A, and Benincasa, Gratiosus (1467): London: BL, Add. MS. 11547.

226 The hand is a common humanist script, but could plausibly be that of Prosper Camulius himself.

was applied on the flag of Genoa and on Lanzarote. Three other islands were decorated, in typical fashion: Rhodes (the silver cross on red of the Knights Hospitallers, Majorca (alternating red and gold stripes for the arms of Aragon), and Tenerife (a four-lobed white flower on red).[227] Gratiosus depicted no wind roses throughout the atlas, and there were no geographical features except rivers.

Figure 2.5.6: The city vignette of Genoa depicted on the 1468 Gratiosus Benincasa atlas, f. 5v. Note how the colour overlays the toponyms below, which, unlike in Figure 2.5.6, were not parted to allow for the illustration. Image from: Pujades i Bataller (2007) DVD Supplement.

The atlas was made without considerable decoration, but unusually, a large city vignette was drawn for Genoa on Plate 4 (ff. 5v-6r), with five Genoese flags using a silver paint which has since tarnished to a greyish-blue. A smaller vignette appears on Plate 3 (ff. 4v-5r) for Venice, but is without heraldry. Most of Benincasa's maps lacked any city illustrations, but this one included two. Furthermore, the size of the Genoese vignette was approximately three times larger than Venice. The reason would seem to be because the map was made for Prosper Camulius of Genoa.

Figure 2.5.7: Illustration of Venice depicted on the 1468 Gratiosus Benincasa atlas. f. 4v. Note how the toponyms were parted to allow for its inclusion. Image from: Pujades i Bataller (2007) DVD Supplement.

While the vignette of Venice was planned for (demonstrated by the parting of the toponyms), the illustration of Genoa was drawn after the toponyms and obscures them, indicating that it was originally unplanned. This suggests that the atlas was not commissioned directly by Prosper Camulius, but was a stock copy, and when bought by

[227] This device appeared on all Benincasa's maps, and probably represents the volcano (Mount Teide). Campbell noted the only portolan chart-maker that used this device before Benincasa was Rafel Soler (active 1425-1450). See: Campbell: (2009).

him, a city illustration of Genoa was requested and inserted. The content of the atlas however, and its ownership by a Papal nuncio, indicate that it was not designed for navigation, but rather for Camulius' personal scholarship and pleasure.

Benincasa's Cartography and Legacy

Between 1461 and 1482, Gratiosus Benincasa produced a total of twenty-three portolan maps (six charts and seventeen atlases) that have survived, plus a further three un-authored but confidently attributed ones. These maps were largely standardised: of his atlases, each folio covered the same geographical area and they were arranged in the same order with few exceptions. The only significant evolution of Benincasa's atlases was adding another map to incorporate new African discoveries.[228] His surviving charts meanwhile, were of the same scale and geographical coverage as the atlases (but all on a single sheet), and retained the same appearance: a "crisp elegance,"[229] beautifully and carefully drafted and written, without considerable decoration. The only exception was his 1482 chart,[230] made for Cardinal Raffaele Riario, which was covered in numerous illustrative motifs, explanatory texts, and decorations.

Benincasa copied the earlier models of Franciscus and Batista Becharius, as demonstrated by hydrographic comparison and the '*Lacus Fortunatus*' inscription. It is surmisable that Gratiosus purchased a Becharius map in Genoa in 1461, and used it as his exemplar. Campbell suggested that besides the Bechari, Benincasa drew heavily from the maps of Andrea Bianco and Bartolomeo Pareto, as demonstrated by the content of the Baltic, and the inclusion of the *Antillia* islands.[231]

Three portolan maps survive from his son Andrea: an atlas from 1476 and two charts from 1490 and 1508, but these were the products of only part-time workmanship; Andrea was a galley commander, and later (in 1496) appointed 'captain of the port' of Ancona.[232] Andrea retained much of the content of his father's maps and copied much of the stylistic content, but all three were considerably more embellished than those of Gratiosus.

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[228] For more on the expansion of the African littoral on Benincasa's maps, see: Ibid.

[229] Campbell: (2011).

[230] Bologna, Biblioteca Universitaria, Rot. 3.

[231] *Antillia* and *Salvaga* only appear on the 1463 London Atlas: BL, Add. MS. 18454.

[232] Emiliani, Marina: 'Le carte nautiche dei Benincasa, cartografi anconetani', *Bollettino della Reale Società Geografica Italiana*, 73 (1936), 485-510. p. 488.

Other successors and imitators of Benincasa's work included: Conte di Ottomanno Freducci, from whom three charts (and a further three attributed) and eight atlases, produced between 1497 and 1539 survive; his son Angelo Freducci, from whom two charts (plus one more attributed) and two atlases, dating from 1547 to 1556 exist; and the Cretan Giorgio Sideri il Callapoda, from whom six charts (and one more attributed) and four atlases produced between 1537 to 1565, survive. The 1538 Conte Freducci atlas, examined at the British Library, was clearly derived from Benincasa, and perhaps directly copied.[233] The areas in the atlas correspond exactly to the main five maps in the Benincasa atlases; Freducci used the same corner scales, the '*Lacus Fortunatus*' text, and same styles for the Madeira and Canary islands.

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[233] Freducci, Conte Octomanno (1538): London: BL, Add. MS. 22348.

The 1489 Chart of Albinus de Canepa

Although Genoa has commonly been considered one of the three centres of portolan chart production in the fourteenth and fifteenth centuries, the reality was that most Genoese chart-makers worked elsewhere; e.g., the Vesconti in Venice, and Dulceti in Majorca. Until the sixteenth century, the only chart-makers active in Genoa were: Giovanni da Carignano (a fourteenth-century priest who was not a full-time cartographer), Bartolomeo Pareto (another priest from whom one map survives, dated 1455), Agostino Noli (active in the fifteenth-century), and Albinus de Canepa. Anconitan cartographer Gratiosus Benincasa operated in Genoa in 1460/61, and although the only surviving map of Genoese cartographer Franciscus Becharius was made in Savona, it is possible he operated in Genoa for some time during his career. The same can be said for his son, Batista Becharius from whom four charts survive but are not provenanced. Nevertheless, in comparison with the number of maps originating in Venice or Majorca, Genoa was far less prolific. Astengo posited that the Republic could not have been a flourishing centre of cartography in the mid-fifteenth century because of a document pertaining to Agostino da Noli,[234] who received a tax exemption because he was the only active cartographer in the city, and was struggling to make a living.[235]

Campbell noted that the only the chart-maker wholeheartedly devoted to Genoa was Albinus de Canepa.[236] Little is known about Canepa, for whom there is no archival evidence. Moreover, besides a few comments made by Campbell in his 1987 chapter, virtually nothing has been published regarding Canepa: his two extant maps were too late to be included in Pujades' study, and too early to be considered by Astengo. Furthermore, there are few references to him in any publications. Thus, everything about his cartographic practice must be gleaned from his two surviving maps.[237]

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[234] Astengo: (2007), p. 209.

[235] Campbell: (1987), p. 430. Regrettably, no charts by Noli have survived.

[236] Ibid. p. 438.

[237] They are: (1480) Rome: Società Geografica Italiana, Rari Z B 17834; (1489) Minneapolis: JFBL, B1489mCa.

Figure 2.6.1: The 1480 chart of Albinus de Canepa in Rome: SGI, Rari Z B 17834. Image courtesy of the Società Geografica Italiana and downloadable at: http://www.societageografica.it/opac/viewer.php?i=17834.jpg [Accessed 14 October 2013].

Figure 2.6.2: The 1489 chart of Albinus de Canepa in Minneapolis: JFBL, B1489mCa. Image courtesy of the James Ford Bell Library.

Predecessors

His two extant maps indicate Albinus da Canepa was operative in the 1480s, though the mastery of the earlier chart suggests he had been a chart-maker for several years prior to 1480. Because there is no documentary evidence of him, it is difficult to establish where and by whom he was trained. Hypothetically, if Canepa died in the 1490s or early 1500s, he was probably an apprentice no earlier than 1450, and no later than 1475. His potential masters could therefore have been an aging Agostino da Noli, or Gratiosus Benincasa during his sojourn to Genoa. Batista Becharius is unlikely because his latest map dates to 1435. Bartolomeo Pareto, a priest, is also unlikely, but within the realm of possibility. Canepa may have learnt his craft in Majorca (possibly under Petrus Roselli), or even in Venice. There might also have been a completely unknown cartographer constituting a missing link, who operated in Genoa between Noli and Canepa.

Both of Canepa's charts were nearly identically decorated: the only significant differences in ornamental content are the more numerous flags on the 1489 chart, and the presence of expository texts on the earlier one. Also, whereas the earlier chart depicted actual monarchs, the later one included only empty tents. Much of this content can be traced back to earlier maps: the two large mythical Atlantic islands of *Antillia* and *Salvaga* first appeared on the 1424 Zuane Pizzigano chart, and were also drawn by Batista Becharius, Rafael Soler, Bartolomeo Pareto, Petrus Roselli, and Gratiosus Benincasa. On both charts, Canepa adopted the '*Lacus Fortunatus*' text in Ireland which originated with Batista Becharius and was proliferated by Benincasa. Though monarchs had been drawn since the charts of Angelino Dulceti, the first map to enclose them in tents was the c.1440 Florence chart attributed to Gabriel de Vallseca,[238] a particular motif also adopted by Petrus Roselli.

Visually, Canepa drew influences from both the Bechari/Benincasa lineage, and the later maps of Petrus Roselli. In terms of content, the most specifically similar charts to Canepa's 1489 map are Petrus Roselli's 1466 and 1468 charts. The nearly identical alternating red and blue of the empty tents, the green scale-like painting of the Atlas mountains, the course of the Danube with its three large islands and city illustrations, and the shape of the southern Baltic Sea coast leaves little room for doubt that Canepa copied a similar chart of Roselli's, and perhaps Canepa even apprenticed in the Roselli atelier.

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[238] Florence: BNC, port. 16.

Figure 2.6.3: Petrus Roselli's 1466 chart in Minneapolis: JFBL, 1466 mRo. Image from: Pujades i Bataller (2007) DVD Supplement.

Figure 2.6.4: Petrus Roselli's 1468 chart in New York: HSA, K35. Image from: Pujades i Bataller (2007) DVD Supplement.

The Chart of 1489

Albinus de Canepa's portolan chart of 1489 measures 80 cm by 120 cm, and is comprised of two pieces of parchment glued together vertically. It features a single standard rhumb-line network. The scale of the map was slightly larger than usual: 1.2 cm per 50 *miglia*. Only a few charts were copied at this scale, according to Pujades' calculations, but it seemed to be the favoured scale size of Batista Becharius, who was influential on Canepa's hydrography.[239] Roselli, who may have been Canepa's primary influence (or even master), usually only made maps at a 1.0 cm scale, but a single anonymous chart, roughly dated to the mid-15th century and attributed to Roselli, is scaled at 1.2 cm.

Canepa's script is a rather thick and round late-gothic hand, quite legible by comparison with earlier charts that employed a more angular script. His spellings were consistent, and thoroughly Genoese rather than Venetian or Catalan. Examination of the toponyms suggests that the black ones were written first: there were several instances where a red toponym had to be reduced in size or written over two lines to fit into the space provided. Additionally, Canepa reduced the size of the toponyms to fit every one possible, which is especially apparent in the Aegean.

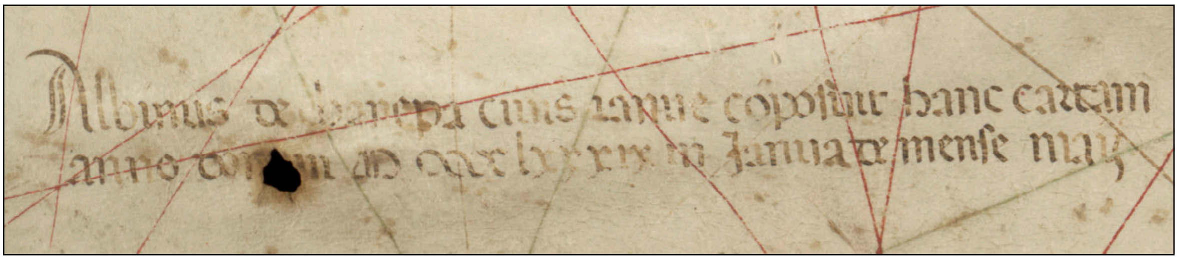

Figure 2.6.5: Albinus de Canepa's signature on his 1489 chart in Minneapolis: JFBL, B1489mCa. Image courtesy of the James Ford Bell Library.

His signature, located in the Atlantic, reads: "Albinus de chanepa ciuis ianue composuit hanc cartam anno domini m ccccl xxxix in Ianua de mense maii". Though Canepa was (and is) a quite common surname in Genoa, it is possible that Albinus was born in the village of Canèpa, located midway between Genoa and Rapallo. Not entirely unique, but nonetheless unusual, was Canepa's reference to Genoa twice in his signature, both that he was Genoese, and that the map was made there. He did the same on his 1480 chart. Certainly, Canepa was proud of the Republic, and it is for his grandiose promotion of the city that this map is best known.

[239] See: Pujades i Bataller: (2007), pp. 204-206.

Hydrography

The map included the whole of the Mediterranean, Black Sea, and Atlantic Europe. The Baltic was drawn in its usual simplified state, largely in the same way it had first been depicted by Angelino Dulceti in 1339. The African Atlantic coast was depicted only as far south as Cape Bojador, even though there was enough space on the parchment to fit another two hundred miles of mapped coastline, which had been available to cartographers for several decades. It is unlikely that Canepa lacked access to maps of the African coast, which indicates that Canepa was uninterested in mapping Portuguese discoveries, only depicting the coast as far south as Genoese sailors had explored; naturally, the island of Lanzarote was drawn with a Genoese cross of St George. The same was true of his 1480 chart.

The Canaries, Madeiras, and the misplaced Azores were depicted in the same manner as the 1403 Becharius chart as well as many later maps, and, typically, were labelled the '*Insule Fortunate Sancti Brandani*'. Although the Azores had been formally discovered by Diogo da Silves in 1427, and mapped in their correct location and orientation by Gabriel de Valseca on his 1439 chart,[240] many portolan chart-makers continued to include the island chain is its more archaic and incorrect form, which is not indicative of a navigational function.

Northwest of Scotland, Canepa included a large ovular island named '*Insula de stitilant*', painted with a large city. It has been debated whether or not this island was mythical, or one of the first portrayals of Iceland, but it was first depicted by Angelino Dulceti on his 1330 chart.[241] Although no chart of Roselli's mapped north enough to depict it, the 1439 Valseca chart included the island, also with a large city illustration, and the text: "Insula stillanda que an la lengua de noruega".[242]

Canepa also included the two large islands of *Antillia* and *Salvaga* in the Atlantic. First drawn on the 1424 portolan of the Atlantic, attributed to Zuane Pizzigano,[243] the islands

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[240] Valseca included the following legend next to the Azores on his 1439 map: "Aquestas illes foran trobades per Diego de Sivils, pelot del rey de Portogall, an l'ay m cccc xxvii". "These islands were discovered by Diogo de Silves, pilot of the King of Portugal, in the year 1427". Translation by: Pujades i Bataller: (2009), p. 358.

[241] Campbell discussed the debate in his 1987 chapter: Campbell: (1987), p. 414.

[242] "The island of Iceland on which the language of Norway [is spoken]".

[243] These islands are discussed in greater detail in the Petrus Roselli case study.

persisted on maps for over a century, and were included in the Atlantic even after the discovery and mapping of the New World. This demonstrates the nature of portolan map creation, which was highly mimetic: chart-makers would copy, often without critical thought, maps that had been made before. Just because Canepa included the two mythical islands does not necessarily mean that he believed in their existence, or that he wanted to include them because they were legendary and interesting, but simply that the maps he copied had included them. On his maps that extended far enough to the west, Petrus Roselli always included *Antillia* and *Salvaga,* except on his earliest chart from 1447.

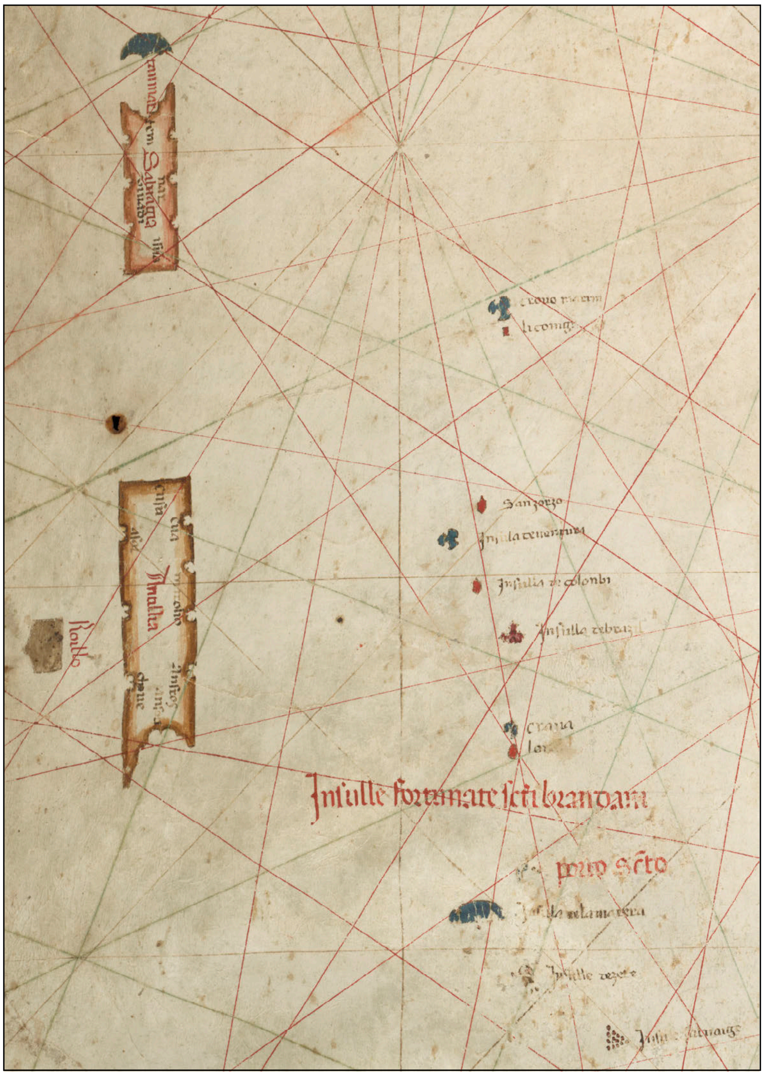

Figure 2.6.6: The Atlantic islands from Albinus de Canepa's 1489 chart, showing the large landmasses of *Antillia* and *Salvaga* in the west. Image courtesy of the James Ford Bell Library.

Examination of the coastline shows that Canepa continued the practice of exaggerated headlands and promontories, and geographically simplified bays. He drew many 'lollipop protuberances', which became increasingly commonplace in the fifteenth century.[244] Canepa also drew single lines jutting into the sea that were undoubtedly intended to represent incredibly thin promontories.

244 See: Campbell, Tony: 'Explanatory notes and wider implications of 'The colours and shapes used to denote some of the smaller islands and the major estuaries on portolan charts up to 1500'', (2011) <http://www.maphistory.info/PortolanColourNotes.html> [accessed 31 January 2013].

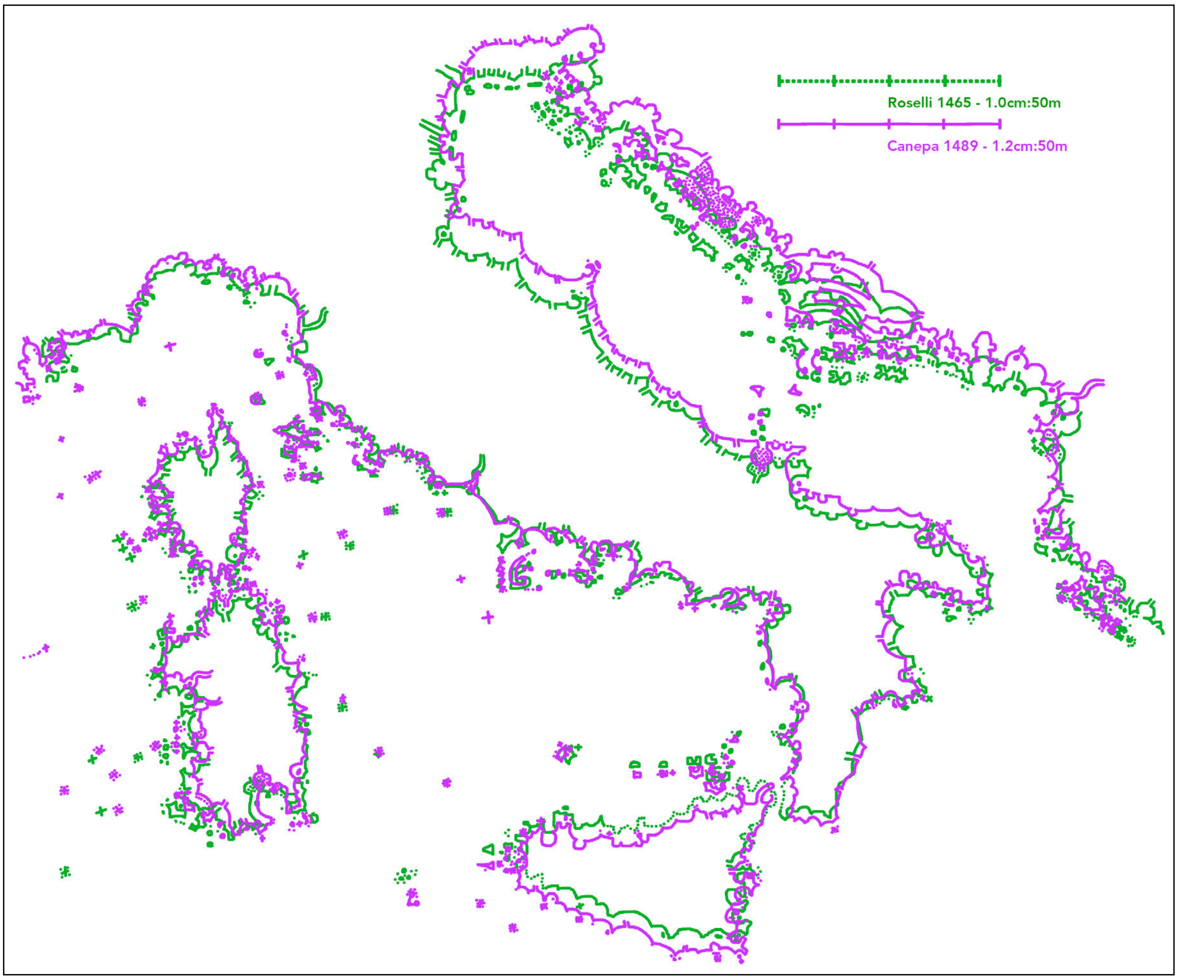

Figure 2.6.7: Superimposition of the coastlines of Italy from the 1465 Roselli chart and the 1489 Canepa chart. Digital tracings made from images courtesy of the James Ford Bell Library and Pujades i Bataller (2007) DVD Supplement.

Comparison of Canepa's coastline with other portolan maps showed a close match to Roselli's 1465 chart. This reinforces the hypothesis that Canepa was trained in the Roselli atelier, or was using a Roselli map as his exemplar. Although the Adriatic appears crooked in figure 2.6.7, when that basin is aligned by rotating one or the other 2.5 degrees, the Adriatic becomes nearly identical on the two maps. Hydrographic comparisons made throughout this thesis has shown this to be a common occurrence, and it indicates that copying occurred through the use of several smaller sheets, which were not always perfectly aligned. If further hydrographic comparison continues to demonstrate that these misaligned basins were standard, it would suggest that the charts were not being directly copied using the back-lit tracing technique, or the square-grid method, but using intermediate transfer sheets which were not aligned correctly.

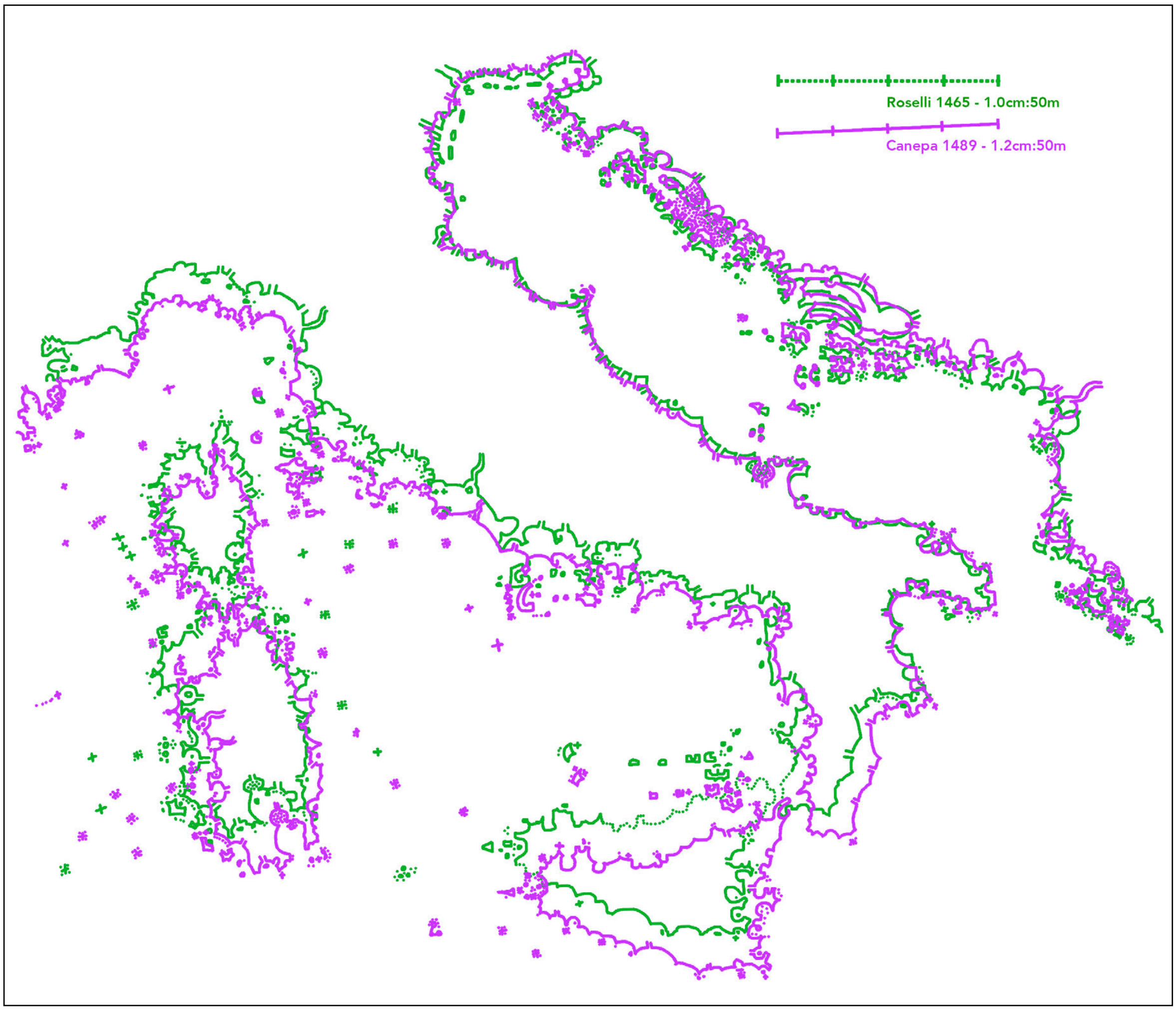

Figure 2.6.8: Superimposition of the coastlines of Italy from the 1465 Roselli chart and the 1489 Canepa chart, with the Canepa chart rotated 2.5 degrees west to align the Adriatic, which, as a result, appears almost identical. Digital tracings made from images courtesy of the James Ford Bell Library and Pujades i Bataller (2007) DVD Supplement.

Ornamentation

It is highly unlikely that Canepa's 1489 chart was meant for navigational use, given its considerable decoration and resulting expense. Instead, the utility of the map is found within its ornamentation: the 1489 chart demonstrates that Canepa, or the patron for whom the chart was made, was a fervent Genoese patriot.

City Illustrations

The 1489 portolan map depicted a total of fifty city illustrations, ranging from quite small (with only a couple towers), to the largest, Genoa, which was more than double the size of the second largest, Venice, and covered roughly the same space on the map as Scotland. Most of the vignettes were comprised of largely nondescript urban buildings without any particular characteristic features. Exceptions were: Genoa (discussed below); Venice, surrounding which Canepa drew water; and Mount Sinai where he drew Saint Catherine's Monastery with its bell tower at the base, and the small mosque at its summit. The cathedral of Santiago de Compostela in Galicia was also depicted, but not entirely realistically: by the fifteenth century, the cathedral had three large towers, not one.

Figure 2.6.9: City illustrations of Genoa and Venice on Albinus de Canepa's 1489 chart. Image courtesy of the James Ford Bell Library.

Genoa, more than any other city, was drawn with its architecture and layout in mind. Comparison between Canepa's drawing and the depicted bird's-eye map by Georg Braun and Frans Hogenberg from the *Civitates Orbis Terrarum* (edited 1572-1617) reveals many accurate features, including: the leftmost 'torre della lanterna', Genoa's famous lighthouse, which was built in the first half of the twelfth century; the tower of the old mole, jutting out into Genoa's harbour from the east; the numerous church spires of the city; and the large central square tower of the 'Torre Grimaldina' or 'Torre del Popolo' of the Palazzo Ducale, which was built around 1300. Many of these features were also depicted on a map of Genoa in the 1493 Nuremberg Chronicles.[245]

Figure 2.6.10: The city of Genoa, depicted in Braun & Hogenberg's *Civitates Orbis Terrarum*. Image from: http://themanbooker.files.wordpress.com/2011/07/genoa.jpg [Accessed 14 November 2013].

245 Schedel, Hartmann: *Liber Chronicarum* (Nuremberg: Anton Koberger, 1493). <http://cudl.lib.cam.ac.uk/view/PR-INC-00000-A-00007-00002-00888>, f. 58v.

Figure 2.6.11: Genoa, depicted in the 1493 Nuremberg Chronicles: f. 58v. Image downloaded from: http://upload.wikimedia.org/wikipedia/commons/d/d3/Nuremberg_chronicles_f_58v_1.png Accessed 14 November 2013].

Figure 2.6.12: The earliest realistic city illustration of Genoa, appearing on the Pizigani brothers' 1367 map in Parma: BP, MS. Parm. 1612. Image from: Pujades i Bataller (2007) DVD Supplement.

Canepa's image of Genoa was not new. The first extant map to depict the city in a realistic manner was the 1367 Pizigani brothers' chart, where the lighthouse on the left, the mole tower on the right, and the city behind are barely discernible after centuries of fading. Until the fifteenth century however, few charts depicted Genoa in a realistic manner, until the 1403 Becharius chart, where the progenitor of Canepa's illustration can be seen (figure 2.3.10). Batista altered his father's illustration to become more realistic, and the depiction of Genoa in his 1435 chart became the exemplar for many later maps.

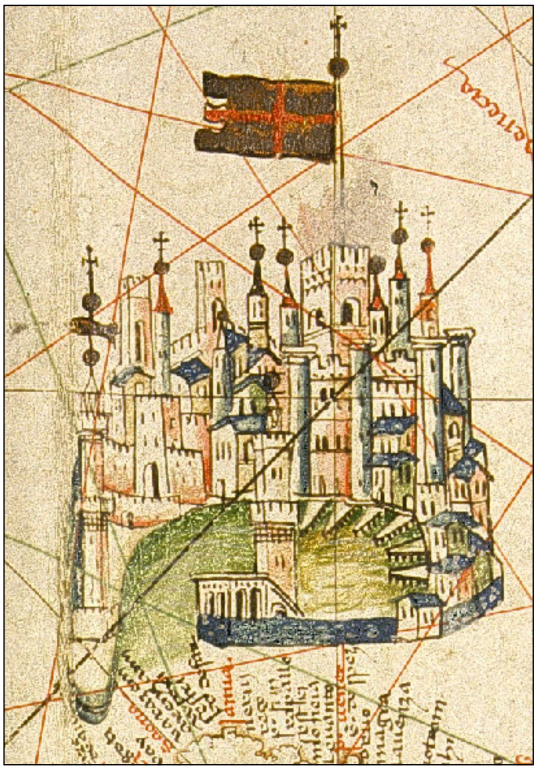

Figure 2.6.13: The depiction of Genoa, on the 1435 Batista Becharius chart in Parma: BP, MS. Parm. 1613. Image from: Pujades i Bataller (2007) DVD Supplement.

Vexillography

The 1489 Canepa chart is known for its depiction of flags more than for any other aspect. Tony Campbell noted that Canepa's chart was the best example of "medieval flag-waving" which "turned the Black Sea into a Genoese lake".[246] The flags were highly promotive of the Republic and its trade interests, but to such an extent that they went beyond patriotism, towards a willful denial of the decline of Genoa.

In all, thirty-five flags were drawn on the map, plus an additional two including Lanzerote and Rhodes (decorated as standard, with the flag painted directly on the island itself). Of these thirty-seven, fourteen depict the Genoese cross of Saint George, twelve of which were flown above port cities around the Black Sea, as shown in figure 2.6.14. These included (clockwise from Constantinople): '*pera*' (across the Golden Horn from Constantinople), '*la ginestra*', '*pidea*' (probably Illice, modern Perekop), '*cenbara*' (Symbolon, conquered in now modern Balaklava), '*sodai*' (Soldaia, modern Sudak), '*caffa*' (modern Feodosiya), '*tana*' (Tanais), '*matrica*', '*sauastopoli*' (modern Sukhumi), '*flonda*', '*simiso*' (modern Samsun), and '*samastro*' (Amastris, modern Amasra).[247] Though all were once Genoese possessions, they were all conquered by the Ottomans between 29 May 1453 when Constantinople fell to Mehmed II, and 1475 when Caffa, the last Genoese stronghold, was defeated. Most wealthy Genoese citizens were expelled from these colonies to Pera, where limited trading rights had been retained after it surrendered to the Ottomans in 1453, though Epstein noted the colony quickly lost importance to the Republic.[248]

These colonies and territorial possessions, in addition to others that were labelled but not assigned a flag, were important to the Genoese economy in the thirteenth and early fourteenth centuries: Scammell wrote that Genoa reached its zenith of economic prosperity around 1293, largely a result of Black Sea trade routes.[249] However, the combination of the

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[246] Campbell: (1987), p. 401.

[247] Genoese trading centres and fortresses also included (clockwise from Constantinople): Varna ('*uarna*' on Canepa's chart); Constanța ('*chabacra*' on the map); Licostomo ('*licostomo*') on the north side of the Danube river delta, which was also known as Kilia Vechia (modern Chilia Veche); '*Vecina*' and '*Suceava*' farther up the Danube river; Maurocastro ('*moncastro*'), which was also known as Akkerman on the Dniester delta; the lost castle of Illice at the mouth of the Dnieper (which may be the same as '*pidea*' above), Vosporo ('*uspro*' on the map / modern Kerch) on the entrance to the Sea of Azov; '*Copa*' (modern Temryuk) on the Kuban River; nearby Anapa ('*mapa*' in black ink on the map); Anakira (modern Anaklia) on the eastern coast which was not on the map; '*Fasso*' (modern Poti) on the east Black Sea coast; Sinope on the south coast of the Black Sea, and others.

[248] Epstein, Steven A.: *Genoa & the Genoese* (Chapel Hill, NC: University of North Carolina Press, 1996). p. 285.

[249] Scammell, G. V.: *The World Encompassed: The first European maritime empires c. 800-1650* (London: Methuen, 1981). pp. 165-166.

Figure 2.6.14: The twelve Genoese flags placed around the Black Sea on Albinus de Canepa's 1489 chart. Image courtesy of the James Ford Bell Library.

Genoese naval defeat by the Venetians at Chioggia in 1380, rapidly increasing debt, conflicting Guelphs and Ghibellines, and political turmoil, caused the city-state to begin a slow decline. Political crises and unresolvable family feuds caused the Genoese to cede lordship of their city to Charles VI of France between 1396 and 1409, when, on 3 September, a popular deposition of the French governor Boucicaut replaced French lordship with the Marchese of Montferrat, who ruled as Doge for one year.[250] In 1421, Genoa again turned to foreign governance, and until 1435 was ruled by successive Milanese governors. From then until 1528, when Andrea Doria reclaimed the independence of Genoa with the help of Charles V, the city was little more than a pawn between Milan, France, and Aragon, with a struggling economy. Epstein estimated that by 1470, trade with the east amounted to no more than 150,000 ducats per annum, between a quarter and a sixth of what Venice's eastern trade was generating.[251]

At the time Canepa was making his charts, Genoa had recently, within the memory of a single generation, lost its last vestiges of empire, and was more often than not controlled by an external nation. The only fully-functioning Genoese institution at the time was the Casa San Georgio, which had been growing in influence and capital to such an extent that by the end of the fifteenth century it essentially owned the city-state. However, the Genoese spirit had not been broken, and although they never amounted to anything, plans were made to crusade against the Turks and retake Caffa.[252] It is against this historical backdrop that Canepa made his maps, so it is no wonder that his chart of 1489 is so fervently patriotic.

If the map had been made as stock to sell, it is likely that in this environment a patriotic purchaser would have been found. However, the map is large and extensively decorated; it can be estimated that it would have taken at least two months to create. As a result, it is more likely that a patron commissioned the map as a bespoke item, and specifically requested those flags. Perhaps this patron was a wealthy merchant who had, until recently, been a resident of one of these Black Sea entrepôts and managed a vast trading network. On the other hand, perhaps the patron was employed by the Casa San Georgio, and required a map showing the recently lost colonies. Alternatively, the patron might have been part of a collective attempting to gather support for another crusade, and

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[250] Epstein: (1996), pp. 245, 259-260, 262.

[251] Ibid. p. 274.

[252] Ibid. p. 290.

needed a map to ignite patriotic fervour. Whatever the function of the chart (which was certainly not meant for daily navigational use), and given the turmoil of Genoa at the time, its vexillography is unsurprising.

Conclusion

What can be gleaned from the 1489 Albinus de Canepa chart is that Canepa was a well-trained artist and scribe, that he was active for at least a decade but likely longer, and that unlike most other Genoese chart-makers who found work elsewhere, he remained in his city. Canepa followed in the Dulceti-Cresques-Roselli Majorcan tradition, but also incorporated much of Batista Becharius' maps into his work. It is possible he trained directly under Roselli himself, given the extent of similarity, and the lack of any other likely candidate.

Campbell has suggested that "chart-makers used their flags to deny an unpleasant reality".[253] Certainly, the twelve Genoese flags around the Black Sea on Canepa's 1489 chart were not there to show that each place was a current Genoese holding: the Ottoman conquests would have been well known to everyone. However, postulating that they were an act of denial is perhaps misunderstanding the function of the map. Canepa's chart was in many ways a celebration of Genoa, its discoveries, and mercantile empire. As a didactic map, it would have been useful to encourage others to crusade (as Petrus Vesconte's maps were used), or to encourage a fractious and factious people to unite and govern themselves again. More simply, it might have been commissioned by a patriotic merchant looking to demonstrate to his visitors his erudition and the distant places to which he had travelled and traded.

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[253] Campbell: (1987), p. 399.

The 1567 Chart of Jacopo Maggiolo

The Vesconte Monopoly

Jacobus Maiolus, whose name is more commonly Italianised to Jacopo (or sometimes Giacomo) Maggiolo,[254] was born sometime in the first half of the sixteenth century, to the prominent Genoese cartographer Vesconte de Maiolo (Vesconte Maggiolo). Though little is known about Vesconte's early life and his (presumed) cartographic apprenticeship, he was recalled to Genoa by Doge Ottaviano Fregoso in 1518 after producing portolan charts in Naples. In 1519, the Doge appointed him *magister cartarum pro nauigando* for the city of Genoa, for which he would receive an annual stipend of 100 *lire* as long as he lived in the city and produced charts.[255] The result was a century-long monopoly on Genoese portolan chart production by the Maggiolo family. In addition to numerous planispheres, the corpus of Vesconte's surviving portolan maps include fifteen authored charts (plus one attributed), and five authored atlases (and another one attributed), dating from between 1504 and 1549.[256] Another chart (dating to 1524) was destroyed during the Second World War.[257]

Jacopo Maggiolo, and his brother Giovanni Antonio Maggiolo, were apprenticed into the family business of chart making; a 1525 chart in Parma bears the authorship of both Vesconte and his son Giovanni.[258] A document dated 16 April 1529 by the Genoese Senate ruled that Vesconte's annual stipend and official monopoly would be extended to his sons.[259] Only three portolan charts survive which are attributed to Giovanni Antonio: the aforementioned chart of 1525; one from 1565 and another dated 1575, both of which have an unclear provenance. It is unknown how prolific Giovanni was, but Jacopo clearly became the primary successor of his father's business: thirteen surviving portolan charts were authored by him dating between 1551 and 1602, and another chart is attributed, though unauthored. In 1544, Jacopo also inherited the annual stipend enjoyed by his father.[260] Vesconte however, continued to produce maps until his death, which was

[254] Given no known academic publication has ever referred to Jacopo Maggiolo as Jacobus Maiolus, this thesis will refer to him by his Italianised name.

[255] See: Astengo: (2007), pp. 209-210 and Pizzaleo, Antonello: 'Maggiolo, Vesconte', Dizionario Biografico degli Italiani, vol. 67, (2007) <http://www.treccani.it/enciclopedia/vesconte-maggiolo_(Dizionario-Biografico)/> [accessed 9 April 2013].

[256] Astengo: (2007), pp. 238-260 (Appendix 7.1).

[257] Pizzaleo: (2007).

[258] Parma, Biblioteca Palatina, n. 1623.

[259] Astengo: (2007), p. 210.

[260] Ibid.

sometime between his last authored and surviving portolan chart dated 10 December 1549, and presumably before Jacopo's first authored chart of 19 March 1551 in which he wrote: "condam [*sic*: quondam] Vescontii" meaning "of the late Vesconte".[261]

Whereas Vesconte created at least five portolan atlases, several of which also contained maps of the Far East and the Americas,[262] Jacopo only made charts, and was more conservative in his geography, focusing solely on the Mediterranean.[263] Whereas his father, Vesconte, would have remembered the first news of the discoveries of Columbus and Vespucci, and seen the first maps incorporating the new world, Jacopo would not have known a time when the world was smaller. Furthermore, the politics in Genoa played an important part: Vesconte relocated to Genoa in 1519 while the Republic was in crisis, having been occupied by the French since 1499, and prone to internal political strife between various factions. Jacopo began making his own charts after Genoa had regained its independence and sense of national identity, after the Genoese admiral Andrea Doria reversed his allegiance to the French, and expelled them from the city with the support of the Habsburgs in 1528.[264] Although Genoa had regained its independence, numerous colonial losses to the Venetians and Ottomans in the preceding century transformed it from a maritime merchant empire to the primary financier of the Empire. The bankruptcy of Philip II of Spain in 1557 secured Genoa its final economic foothold, so much so that Fernand Braudel called the seventy years that followed "the age of the Genoese".[265] Genoa changed in the 16th century from looking outward upon the world, seeking secure merchant colonies and new trade routes, to looking inward towards Europe, secure as an economic powerhouse; this may have affected the geography of the maps demanded from Jacopo's atelier.

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[261] Ibid.

[262] For example, the 1519 atlas at the Bavarian State Library in Munich (Cod. icon. 135) depicted the entirety of Africa, part of South America and the Caribbean, the Caspian Sea, southern India and Taprobana (Sri Lanka), in addition to the normal Mediterranean and Atlantic. Additionally, the 1511 atlas in the John Carter Brown library in Providence (2-SIZE Z. Codex 2) included a planisphere most notably described in: Caraci, Giuseppe: 'A Little Known Atlas by Vesconte Maggiolo, 1518', *Imago Mundi*, 2 (1937), 37-54.

[263] An exception was a single chart dating to 1561, in which he included Scandinavia, northwest Africa, the Atlantic as far west as the Azores, and a small planisphere inset. See: Astengo: (2007), p. 210.

[264] Scammell: (1981), pp. 199-200.

[265] Braudel, Fernand: *The Mediterranean and the Mediterranean world in the age of Philip II*, trans. by Siân Reynolds, 2nd rev. edn., 2 vols. (Berkeley: University of California Press, 1995), vol. 1. p. 157. This sentiment was echoed by Scammell who argued the same. Scammell: (1981), p. 156.

Jacopo continued to collect his annual stipend until 1605, though no charts are attributable to him dated between 1573 and 1602. Astengo noted that his 1602 chart had abrasions around the date, suggesting it was an earlier map altered to convince authorities he was still in business and should receive his stipend.[266] Although it could have been happenstance that no charts from that 29-year gap have survived, more likely there was a decrease in his output. Jacopo probably died in or shortly after 1605, around the same time as his nephew Baldassare Maggiolo (the son of Giovanni Antonio) from whom five portolan maps survive. In 1607, the position of *magister cartarum* passed briefly to Gerolamo Costo, who was not of the family lineage, but two years later was restored to the Maggiolo family, with which it stayed until 1649, when the position was dissolved.[267] Few portolan charts and atlases were produced during this late period, which was probably the result of the slow but steady shift away from merchant seafaring to banking,[268] and the increasing popularity and availability of printed maps.

The Nautical Chart of 1567

Locked away for years in a secret storeroom in the Collegio Romano in Rome, five manuscript maps, amongst numerous codices, documents, and other treasures, were found in 1877 by officials of the Vittorio Emanuele Library. Having been made by a then-unknown cartographer, the oldest map in the collection, the 1455 chart by Bartolomeo Pareto, has received the most scholarly attention. However, it is the chart by Jacopo Maggiolo from 1567 that is the most outstanding, for its unusually large scale suggested that it might have been an actual navigational aide, rather than an aesthetic or administrative map.

Although briefly mentioned the year after its discovery (1877) by Pietro Amat di San Filippo, and again in 1931 by S. Crino,[269] Jacopo Maggiolo's 1567 chart[270] went largely unstudied until Corradino Astengo published the most detailed examination of it in 2003. Discussing its content, Astengo concluded: "E che la carta sia stata effettivamente costruita

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[266] Astengo: (2007), pp. 210-211.

[267] Ibid. p. 212.

[268] Genoa lost its last foothold in the east with the fall of Chios to the Ottomans in 1566.

[269] See: Astengo, Corradino: 'Una Carta de Navigare del 1567', *Itineraria: Letteratura di viaggio e conoscenza del mondo dall'Antichità al Rinascimento*, 2 (2003), 289-303. pp. 189-191 (notes 1, 6).

[270] Rome: Biblioteca Nazionale Centrale: Carte nautiche, 5.

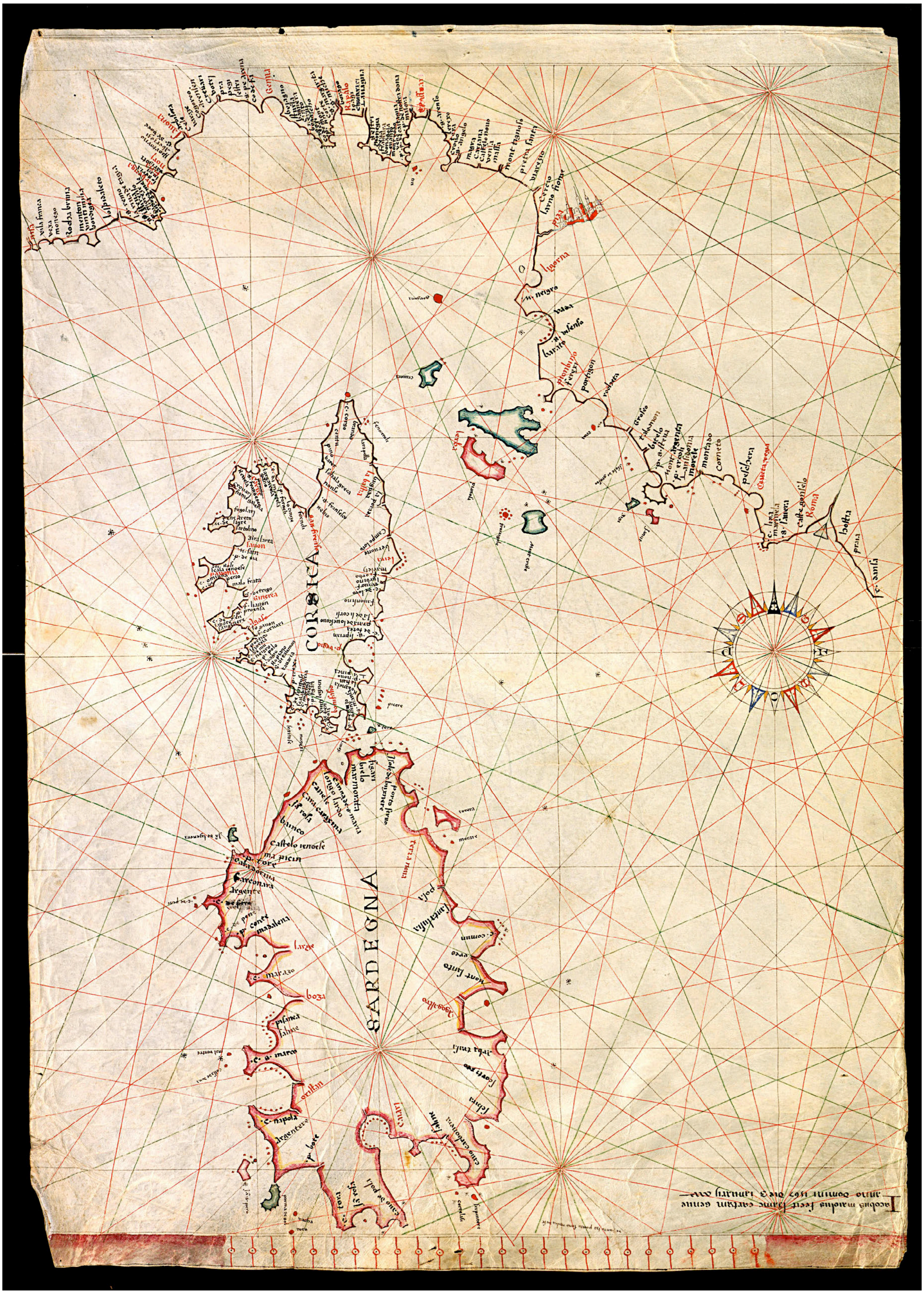

Figure 2.7.1: The 1567 regional nautical chart of Jacopo Maggiolo in Rome: BNC, Carte nautiche, 5. Digital image downloaded from: http://dl.francigena.beniculturali.it/fedora/get/VALITADD:IT-RM0267_CARTA_NAUTICA_5/IMAGE-1-100.jpeg [Accessed 14 November 2013].

per un uso in mare sembra provato, oltre che dalla scale scelta, anche dalla pressoché totale assenza di elementi ornamentali".[271]

Measuring 660 mm x 455 mm, the chart only covers the Ligurian and North Tyrrhenian Sea from '*uila franca*' (modern Villefranche-sur-Mer, just east of Nice), to '*c. dansa*' (modern Anzio, 35 miles south of Rome), and the islands of Corsica, Sardinia, and the Tuscan Archipelago. For such a small region to be exhibited on such a large portolan chart is quite rare. Of the 110 charts and atlases that Pujades measured in his 2007 study, no charts or atlases came close to the same scale; the largest were atlas maps of the Adriatic measuring at between 2 and 2.2 cm per *miglia*.[272] Astengo also noted that all of the charts by Jacopo Maggiolo (except the 1567 one) are of the average scale of 1:6,000,000 (about 1.0 cm : 50 *miglia*).[273] However, the 1567 map measures approximately 4.5 cm : 50 *miglia*. A note next to the lower scale reads: "da ponto ha ponto sono milia dese."[274] This large scale size was highly unusual, and unique for the region; and Astengo noted that the few charts from the sixteenth century close to the same scale represented the Adriatic.[275]

Hydrography

Given the larger scale, one might presume that the coastline and islands would be more detailed. Astengo remarked that because the map had been enlarged from a smaller model, the result was "amplificata a causa della scala scelta e allo stesso modo risultano ingigantiti alcuni errori tradizionali."[276] The exaggeration of harbours and headlands is immediately recognisable, and includes, among others, the harbour of Genoa, and gulfs of Rapallo and La Spezia on the Ligurian coast, Saint Florent and Porto Vecchio on Corsica, and Tortolì and Cagliari on Sardinia. This sort of exaggeration was typical on portolan charts: Campbell noted that islands, capes and headlands were enlarged because of their

[271] "That the chart was actually constructed for use at sea seems proved, not only by the choice of scale, but also the almost total absence of ornamental elements." Ibid. p. 296.

[272] Pujades i Bataller: (2007), pp. 204-208.

[273] Astengo: (2003), p. 292.

[274] "From point to point are ten miles".

[275] Astengo: (2003), p. 292.

[276] "… amplified here because of the scale and the method of construction, resulting in some traditional errors being magnified." Ibid. pp. 190, notes 190-191.

navigational significance, and that the stretches of coast between headlands tended to be more standardised and geometric than realistic.[277]

However, despite its enlargement, the hydrography of the littoral was not different between Jacopo Maggiolo's 1567 chart and the standard-sized chart he constructed in 1563,[278] except in the depth of the bay near Viareggio and Pisa, and the size of Pianosa, which is roughly three times larger than in the 1563 map. Figure 2.7.2 depicts the coastline of the 1567 chart in red, and the coastline of the 1563 chart by Jacopo Maggiolo in white, superimposed upon the actual shape of Italy.

The similarity between the two coastlines demonstrates that Jacopo Maggiolo likely used the same exemplar to make both maps. The 1563 chart would probably have been copied at a 1:1 scale, most likely using the '*trasflorar*' method described by Martín Cortés. The larger-scaled 1567 map would have probably been produced using the '*quadratura*' method, in which two grids of corresponding squares of different sizes allowed the chart-maker to copy the coastline by hand, one square at a time, producing a different scale from the original. This would have resulted in small variations but with the same overall shape, which is visually apparent in figure 2.7.2.

Comparison of the coastline between the two charts shows that little differs between the two maps: nearly every dot, shoal, headland and bay corresponded to a matching one on the other map. A slight exception can be seen on Corsica on the 1567, where there were more river inlets and a few more red dots around the coast (referring to tiny islands), and tiny red dots around the bay of Oristano on Sardinia (referring to sandy shoals). Although the coastlines of the two maps do not match perfectly, visual tracing from headland through bay to headland etc. shows that for the most part, every major hydrographic feature appeared on both charts.

It is apparent therefore, that despite being on a far larger scale, the hydrography of the 1567 chart was no different from any typically-scaled portolan chart. Could the map have been more useful for practical navigation than a typical portolan chart if its hydrography were no more precise? The fact that the coastline was not depicted more accurately indicates either that this was the highest level of hydrographic knowledge at the time, or the littoral was unimportant for the utility of the map, which seems unlikely, even if

[277] Campbell: (1987), p. 377.

[278] Paris: BN, S. G. Y. 1704.

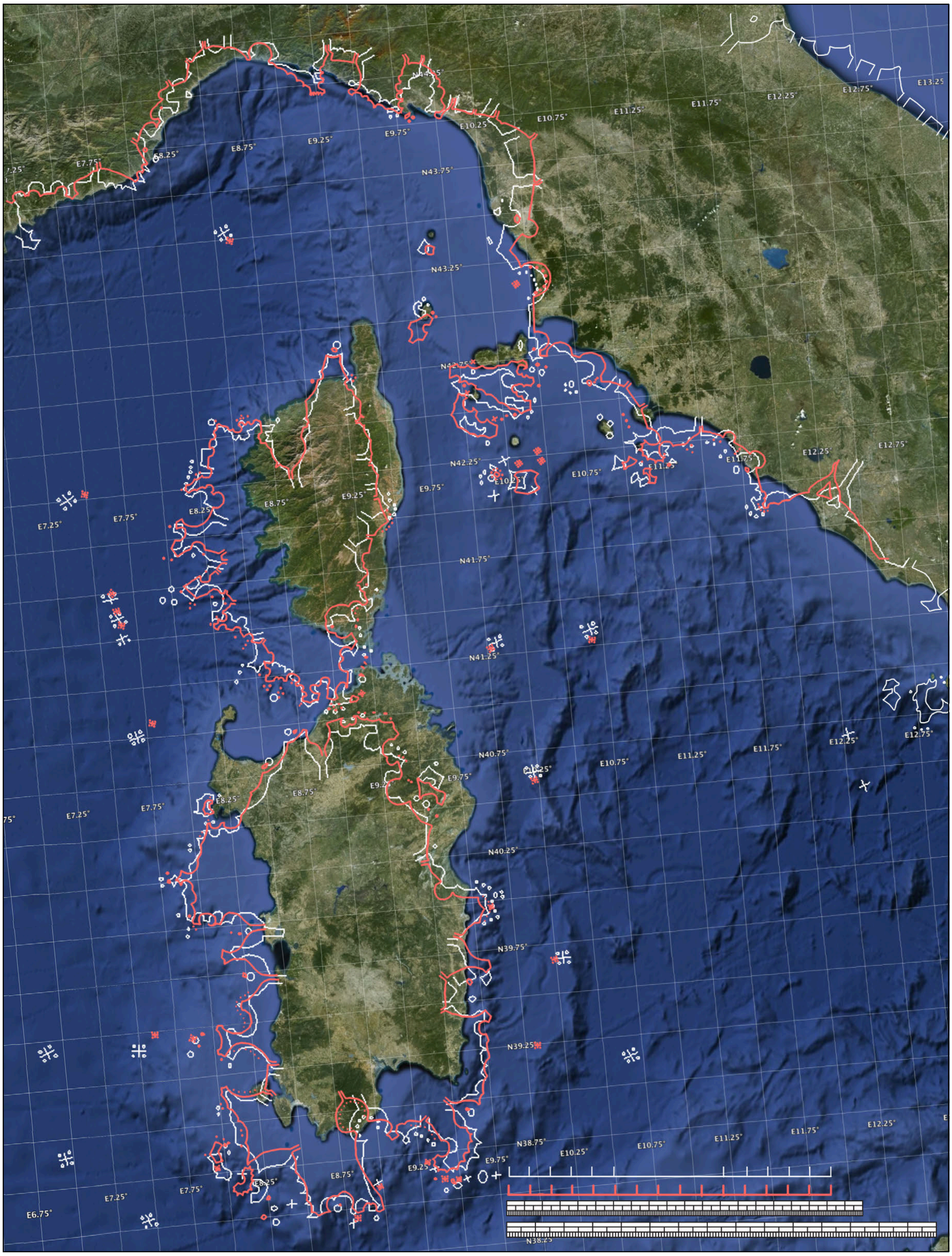

Figure 2.7.2: Superimposition of the coastlines from Jacopo Maggiolo's 1567 regional chart (red) and 1563 normal portolan chart (white), over satellite imagery. Digital tracings taken from images courtesy of the Biblioteca Nazionale Centrale in Rome and the Bibliothèque Nationale in Paris. Satellite imagery from Google Earth.

its function was archival or aesthetic. If intended for navigation, then the littoral must have been good enough for navigation. Alternatively, this regional map was not used for navigation as Corradino Astengo proposed.[279] Although he examined the chart itself in Rome, Astengo made no mention of finding any use-wear markings, such as pinpricks from measuring dividers.

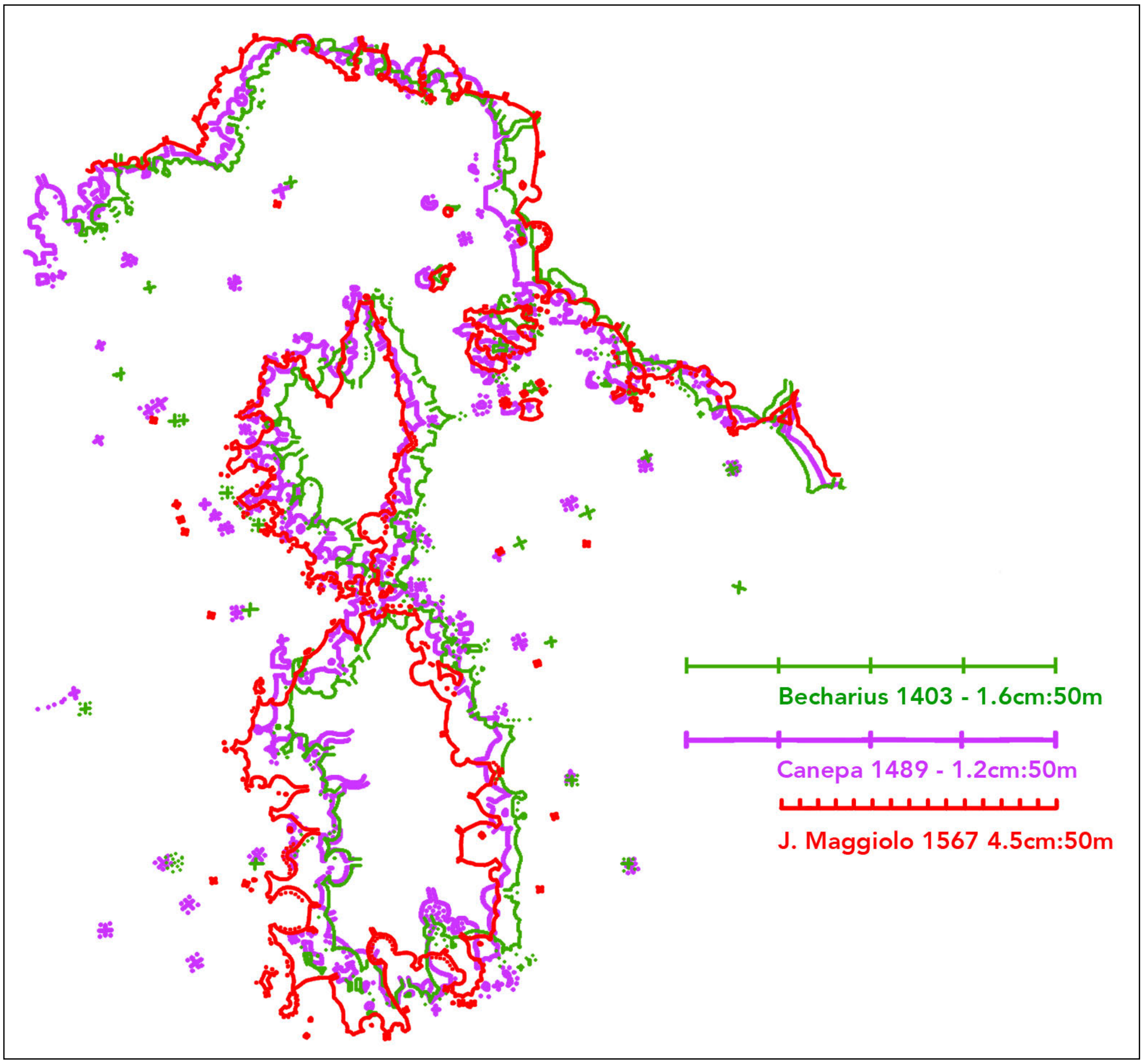

Figure 2.7.3: Superimposition of the coastlines from Jacopo Maggiolo's 1567 regional chart, Albinus de Canepa's 1489 chart, and Franciscus Becharius' 1403 chart. Digital tracings were taken from images courtesy of the Biblioteca Nazionale Centrale, the James Ford Bell Library, and the Beinecke Rare Book and Manuscript Library.

Comparison of the coastlines from Maggiolo's 1567 chart, Franciscus Becharius' 1403 chart, and Albinus de Canepa's 1489 chart, reveals that Maggiolo was not using an exemplar derived from the Becharius tradition. The scale of Sardinia appears entirely archaic: the size and shape of it was closer to that of Angelino Dulceti's map of 1339,

[279] Astengo: (2003), p. 296.

made over two centuries earlier. Presumably, Jacopo was using an exemplar made by his father Vesconte, but it is surprising that the coastlines did not match any other charts made in Genoa studied thus far. The hydrography of Jacopo's chart, despite its large scale and appearance of utility, was more incorrect than most fifteenth-century and many fourteenth-century maps. That the littoral was deteriorating is indicative that hydrographic accuracy was not essential to a chart's function, which does not suggest a navigational utility for the genre.

Toponymy

Where the chart of 1567 and Jacopo Maggiolo's other portolans differ considerably was their toponymy. Astengo compared the toponyms of the 1567 map with a chart of 1561 by the same cartographer,[280] which was found in the same container at the Collegio Romano of the Jesuits.[281] He provided an appendix of the place-names from both maps, which totalled 278 on the 1567 chart, yet only 126 (in the same area) on the chart of 1561.[282] On the aforementioned 1563 chart, the total number was 131 toponyms. The increased number is not evenly spread across the map however: there were concentrations of additional place-names only along the Ligurian coast from Nice to Viareggio, and on Corsica.

More specifically, on the 1567 map, there were 83 toponyms along the Ligurian coast, whereas there are only 31 on the 1563 chart, and 29 on the 1561. Around Corsica, there were 88 on the 1567 chart, 16 on the 1563 and 13 on the 1561. However, for the rest of the mainland coast, the toponyms numbered 34 (1567), 27 (1563) and 28 (1561). Around Sardinia, the place-names totalled 47 on the 1567 map, which are only slightly more than 33 and 32 for the 1563 and 1561 maps respectively. All but two of these additional toponyms appeared in the north of the island, between '*large*' (modern Alghero on the northwest coast), and '*terra noua*' (modern Olbia on the northeast coast). The additional toponyms on the 1567 map were labelled in black, and there are few place-

[280] Rome: Biblioteca Nazionale Centrale: Carte nautiche, 2.

[281] Ibid. p. 295.

[282] In the text of the article, Astengo numbered the toponyms of each map as 279 and 128 respectively. He also mistakenly wrote '*monego*' twice in the appendix, which does not appear twice on the chart itself, but missed both the toponym '*tin*' which refers to a group of small islands at the mouth of the bay of La Spezia, and '*marinela*,' three toponyms northwest of Rome.

names that did not appear on the regional map yet appeared on the 1563 and 1561 charts. However, these exceptions are worth closer examination.

Along the mainland littoral, all the red toponyms are consistent. However, there are four names appearing on the small-scale charts, which curiously do not appear on the larger map, given its increased density. From the northwest to the southeast, the first of these exceptions is '*megia*' (1563) or '*lamegia*' (1561), which does not appear on the map of 1567. Although Jacopo had space to write in the name of this village on the mouth of the Magra river (which is labelled), he probably chose not to, instead adding the names '*Carzana*' (modern Sarzana), and '*Castelo nouo*' (modern Castelnuovo Magra): two strategically important fortifications controlling that stretch of coastline. The second, '*motron*', was a common place-name on early portolan charts because it was the primary port of Lucca, and was commonly in red. However, by the sixteenth century, Viareggio had become more prosperous and began appearing more frequently, while Motrone fell into decline. In 1513, Pope Leo X removed control of Motrone from Lucca. On the 1563 and 1561 maps, both Motrone and Viareggio were labelled, but on the 1567 chart, the town of Pietrasanta was labelled instead. It is not clear why this is, but future toponymic research might reveal that Pietrasanta slowly replaced Motrone in later portolan charts. The third exception was the town of Castiglione, which appears as '*castigon*' on the 1563 and 1561 maps, and is quite a common place-name on portolan charts, but is absent from the 1567 map, and, unlike the other exceptions, was not swapped with a different name. Finally, Jacopo chose not to label the classical Roman port of Portus, on the north side of the Tiber. Though he did label it on his smaller scale maps of 1561 and 1563, by the sixteenth century, the north fork of the Tiber had silted, and Portus was little more than a village.

On the 1567 regional chart, new red toponyms were only found on the island of Corsica. First, '*la bastia*', in the northeast, was red on the 1567 chart, but black on the others. *Bastia*, however, was a relatively recent toponym, referring to the Genoese stronghold (*bastiglia*) built there in 1383, which slowly replaced a sometimes-used toponym '*coruo*' (modern Cardo) which was small fishing village.[283] Likewise, '*•p• uegio*' (modern Porto-Vecchio in southeast Corsica), which appeared in red on the 1567 chart, black on the 1563, and not at all on the 1561, had only been founded in 1539 by the Genoese Bank of Saint George, so its variability on the charts is not unexpected. The name '*savon*,' which

[283] Although nearly two centuries had passed between the building of the castle, given the generally slow uptake of new toponyms on portolan charts, it is unsurprising that whether '*bastia*' should be red or not was variable.

appeared in red on the 1567 chart cannot be matched to any modern place, but must be just south of Girolata on the northwest coast; it appears in black on the 1563 as '*•p• ſauõ*' and '*p. fano*' on the 1561, but in entirely the wrong place, farther south than it should be. This was likely due to the lack of space on the smaller-scale charts, where there was not room on islands for the toponyms to be placed perpendicular to the coast, but at skewed angles wherever space allowed. Finally, two red toponyms on the 1567 chart – '*Ginerca*' and '*pauonia*' – did not appear on the smaller scaled maps at all.

While Corsica had five red toponyms not appearing in red (or at all) on the other maps, on Sardinia the opposite occurred. The red toponym '*sasari*' on the 1563 and 1561 maps, unusually does not appear on the 1567. Sassari was a major city at the time, and had been capital of the northwest Giudicato of Torres, one of the four medieval kingdoms of Sardinia which were annexed by Aragon in the early fifteenth century. Astengo posited that for a larger-scaled chart, it would have been a mistake to label the city, because it was not on the coast.[284] This seems a reasonable assumption: it was not the habit of portolan chart-makers to label inland cities, and Sassari is more than ten kilometres from the coast. Instead of Sassari, Jacopo Maggiolo chose to put '*•p• tores*' (Porto Torres) in its place, which was the principal port of the region, and a name that does not appear on the maps of 1561 and 1563, presumably because those did label Sassari. This seems to reveal that Jacopo did not blindly copy toponyms for his large-scale regional map, but had either a good personal knowledge of geography, or at least a good reference source, which was further exhibited by his inclusion of a multitude of toponyms that had never appeared before.

Quite striking about the 1567 chart, other than the additional toponyms, is the number of corrections. Generally speaking, it is rare to find more than one or two corrections on a full-sized portolan chart, which usually contains between one and two thousand place-names. However, on this chart, five major corrections can be seen, in addition to a couple minor spelling corrections. While one would expect that this might arise from the addition of new toponyms, four of the five corrections involve standard names, that appeared on Jacopo Maggiolo's other charts and other portolans in general.

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[284] Ibid. p. 296.

First, as depicted in figure 2.7.4, along the mainland littoral, the black toponym '*chiauari*' was corrected from some other toponym, and nearby, the red toponym '*spissar*' was corrected from what appears to be '*chiauari*' though it is not possible to be certain. It would be coincidental if these two corrections were unrelated, given their proximity and (probable) sharing of a place-name. Yet, the first correction is a black toponym, and the second is a red, which is unusual. It is apparent on this chart that the red toponyms were written first, followed by the blacks, which can be seen from the fact that the red toponyms are often larger, whereas the black toponyms in dense areas are shrunk to be squeezed in between the reds, as depicted in figure 2.7.5. If the red names were written first however, whether '*chiauari*' was immediately corrected to '*spissar*', or only noticed and corrected when the black names were inserted, it would have been odd if Jacopo made a second mistake upon writing the same toponym in black later on. Even had he been writing both red and black toponyms sequentially, switching between two pens, he would have still had to make two separate mistakes one after the other, both involving '*chiauari*'. The only plausible explanation is that the exemplar from which he was copying was incorrect: perhaps it had swapped '*chiauari*' and '*spissar*', though even this seems far fetched.

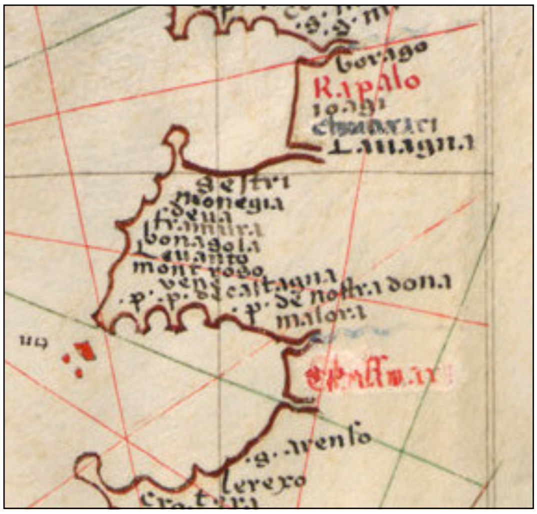

Figure 2.7.4: Toponymic corrections of 'chiauari' and 'ſpiſſar' along the Ligurian coast of Maggiolo's 1567 regional chart. Image courtesy of the Biblioteca Nazionale Centrale.

Figure 2.7.5: Toponymy along the Ligurian coast west of Savona. Note the consistent size of the red toponyms, but how the black ones seemed to be squeezed together to fit, indicative of the red ones having been written first. Image courtesy of the Biblioteca Nazionale Centrale.

Also on the mainland littoral, '*Ciueta vegia*', in red, appears to have been corrected from '*lig__a*' which was erased. There is a possibility Jacopo accidentally wrote '*ligorna*' here, probably because they are each next to two bays of similar size and shape with a identically shaped island next to each. This would have been an easy mistake to make: the experimental reconstruction showed that visual cues from the coastline were necessary for keeping one's place when quickly glancing at the exemplar to find the next toponym, but could also cause mistakes.

On Corsica, the black toponym '*poralo*,' just east of the city of Calvi, was crossed through, but no attempt was made to erase it. Clearly it was simply meant for deletion and there was no intention of replacing it with something else. *Poralo* was not a toponym regularly added to portolan charts, and unfortunately it cannot be attributed to any modern place.

Finally, on Sardinia, Jacopo seems to have had trouble labelling a cape in the northwest, near Alghero. It appears that two place-names had been written: one is now completely obscured, but the other appears to be '*ue_polla*'. Both of these were then erased, and '*•c• de pene*' was written, which was also incorrect, and meant for the next cape a few kilometres south. The final correct toponym was written over pene, making '*•c• de fere*'. Modern maps of Sardinia refer to the beach south of this cape as Porto Ferro (Iron Harbour). '*•c• de fere*' is not a toponym that appears on any other portolan charts that were examined for this thesis, and '*•c• de pene*' does not appear labelled on Sardinia among the place-names written internally, but '*pene*' does appear, written in the sea and referring to two small islands off that cape. Given the large scale of the map, it is not difficult to imagine Jacopo being unsure about the exact locations of certain toponyms, when on a smaller scale map, it would have been impossible to differentiate labelling between the two capes.

Figure 2.7.6: '*•C• de fer*e' and '*•c• de pene*' on the west coast of Sardinia on Maggiolo's 1567 regional chart. Image courtesy of the Biblioteca Nazionale Centrale.

These corrections all appear to have been made during the construction of the chart, and not by a later hand. Palaeographic examination of the colour of the ink and the shape of the letters suggests all of the toponyms were written by the same scribe. Additionally, although the red toponyms appear larger than the black (revealing that they were written first), the fact that the reds are smaller on Corsica than elsewhere shows that at the outset, Jacopo knew that several toponyms were going to be placed around the island,

and thus he would need to be as efficient with space as possible. Finally, although without seeing the original it is not possible to be certain, the uniform colour of the ink, and thickness of the letters indicates that all the black toponyms, both standard and extraordinary, were written sequentially, and not in two separate sequences (i.e. standard ones, then new ones), as might be expected.

The density of additional place-names around areas of Genoese control indicates that Jacopo had access to some sort of additional information that was not regularly used for standard portolan charts, whether it was an individual with considerable toponymic knowledge, or a composition of geography, or both. It is impossible to be certain if Jacopo was copying from another exemplar of equal size, or from a smaller standard chart. That the hydrography of this regional map is virtually identical to Jacopo's other maps demonstrates that it was copied from a smaller-scale, regular portolan chart, and the numerous corrections corroborate this theory, suggesting Jacopo was unfamiliar with maps of this size. However, the sequential placement of the black toponyms could indicate the opposite, or alternatively, that during the construction of the chart, Jacopo was carefully melding the toponyms of a standard chart with those provided to him (perhaps even orally, during construction). This may have led to some confusion and corrections. Overall, it seems likely this map was unique at the time of its creation and was not produced by copying an identical exemplar.

Corradino Astengo concluded, albeit reservedly, that the 1567 chart was made for the Genoese market, specifically for use at sea.[285] The evidence suggests however, that a navigational utility is questionable. Because of its uniqueness, and the fact it has survived, this particular chart was probably not used for navigation itself, though further examination for use-wear marks that are not visible in facsimile could reverse this interpretation. Given that this chart was probably not copied from another similarly-sized map indicates exemplars at this scale did not exist, which suggests that this map was not one of hundreds of large-scale navigational portolan charts, but a rare oddity.

The Chart in its Context

For whom, and for what reason, was this unique regional chart made? It was found along with three other portolan charts: the 1561 Jacopo Maggiolo chart discussed above, a

[285] Ibid.

1561 chart by Jaume Olives produced in Messina,[286] and a much later 1636 chart by Placido Caloiro et Oliva[287] also produced in Messina.[288] These four charts were inside a cylindrical container of bespoke construction with separate compartments to fit all four differently sized maps, thus it was most likely made after the latest one, dated 1636.[289] According to Sebastiano Crinò, the container was of Florentine construction, and the maps belonged to the Knights of Saint Stephen.[290] However, Astengo himself believed that there was little evidence to support this, and pointed out that no dedications or heraldic symbols can be found on any of the four charts which could identify the owner.[291]

Astengo suggested that the map "sia stata costruita per il mercato genovese", and if Crinò was correct, was later bought by a knight of Saint Stephen.[292] Regardless of who owned the maps for which the bespoke container was made, Astengo implied that the 1567 chart was made not by commission, but as open stock to be sold to whomever wished to purchase it. Astengo's explanation for the unusual storage combination of a recently-made chart with three maps from seven decades earlier was that the earlier charts were actually more hydrographically accurate, and he reiterated Crinò's hypothesis that the later chart was made only to provide more up-to-date toponymic information.[293] It is possible that the three older charts had been family heirlooms, and the owner purchased a more recent chart to add to the family collection, without consideration of utilitarian functions, which is all the more possible since it has been established that the regional map was not necessarily a navigational chart.

Given the idiosyncratic nature of the chart, it seems unlikely that Jacopo Maggiolo made it without some specific impetus, and most likely, although there are no dedications, the map was specifically commissioned. It is likely the map was made for someone with a specific desire to have an accurate catalogue of coastal places, specifically Genoese

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[286] Rome: BNC: Carte nautiche, 5.

[287] Rome: BNC: Carte nautiche, 9.

[288] Ibid. p. 290.

[289] It is plausible, albeit quite unlikely, that the 1636 chart was bought at a later date and made to have dimensions to fit the container.

[290] Ibid. p. 291.

[291] Ibid.

[292] Translation: "would have been constructed for the Genoese market". Ibid. p. 296.

[293] See: Crinò, Sebastiano: 'Un astuccio della prima metà del secolo XVII con quattro carte da navigare costruite per la Marina Medicea dell'Ordine de Santo Stefano', *Rivista Marittima*, 64: 2 (1931), 163-174. pp. 171-172 and Astengo: (2007), p. 181.

holdings. Given that Jacopo was the state cartographer, receiving an annual stipend of 100 *lire*, one can surmise that the Genoese state – or some part of it (e.g. the powerful Bank of Saint George) – commissioned the map. Contrary to Astengo's conclusions, this map was probably not meant for navigation, but to record areas under control of the Republic. Given its extensive toponymic catalogue, it is no wonder that it has survived to the present day.

III: Contemporary Evidence

Introduction

A number of documentary sources dating from the thirteenth through seventeenth centuries specifically refer to the existence and use of portolan maps, or provide a context through which their existence can be inferred. The scope of this research project allowed neither the time nor the resources necessary for direct consultation and archival exploration to uncover unknown contemporaneous references involving portolan charts. Thus, this section utilises the archival work of other scholars, with the inherent limitations this poses. Few archives have been thoroughly examined for this evidence, and those that have may not have been explored equally for documentary references which might present a bias in the evidence. Pujades acknowledged that "a rather disappointing gap exists in the case of the Venetian Republic" because of numerous factors, and called on future research to be done in Venice.[1] Campbell noted that there has been a tendency to overestimate the importance of Genoa as a centre of portolan map-making "because Genoese historians have been more active in this field than their Venetian counterparts".[2]

Pujades i Bataller's 2007 study published an invaluable compilation of documents and literature dating from 1200 to 1500 that mention maps in some way.[3] The majority of these documents were not ships' inventories, but personal inventories.[4] This collection, in addition to other published documents, are the subjects of analysis in this section. Pujades derived a conclusion from this evidence that portolan charts were 'numerous and necessary', yet a different conclusion may be drawn from the same material: that navigational utility was at most only one function out of many embodied in portolan maps. Furthermore, the practical considerations of portolan map-making explored in the first

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[1] Pujades i Bataller, Ramón J. : *Les cartes portolanes: La representació medieval d'una mar solcada*, trans. by Richard Rees (Barcelona: Institut Cartogràfic de Catalunya, Institut d'Estudis Catalans, Institut Europeu de la Mediterrània, 2007). p. 428.

[2] Campbell, Tony: 'Portolan Charts from the Late Thirteenth Century to 1500', in *The History of Cartography*, ed. by J. B. Harley and David Woodward, 3 vols. (Chicago: UCP, 1987), vol. 1, pp. 371-463. p. 438.

[3] Pujades i Bataller: (2007), pp. 428-447.

[4] Pujades discussed the clear distinction made between a ship's equipment and the property of the sailors, and that ship's navigators personally owned their own maps: Ibid. p. 425.

chapter, and their theoretical use (discussed in the fourth chapter), instead indicate a different conclusion: that despite some documentary evidence, it is unlikely the maps were useful for navigation, or were produced in great numbers.

Following a discussion of different types of written sources – firstly, literature and technical manuals, and secondly, official records – this chapter will discuss three aspects, evidence about which can be gleaned from written sources. First, patterns of ownership will be assessed, as gleaned from the numerous inventories and bills of sale, and from the maps themselves when their owners were helpfully identified from inscriptions or coats-of-arms. Second, some documents and written sources reveal the cost of these maps, and in combination with the conclusions gleaned from the reconstruction, a better understanding of the economics of the portolan map trade will be established. Third, the written sources provide some clues as to why these maps were bought, and how they were used.

The documentary sources are fraught with limitations; already mentioned was the lack of equal representation of archival records, simply because the many hours of examining manuscripts have not been completed thoroughly in all locations. Undoubtedly, future archival research would pay great dividends. Additionally, the documentary sources are limited by their use of nomenclature for what modern scholars refer to as portolan charts. Lacking a single defined term for these maps, the words used in documents vary from *carte de navigar* to *tabula navigandi* to *mappamundi* and many variants thereof. Pujades, in a discussion of these terms, defended his conclusions that the terms did refer to portolan maps in each of his presented documents, rejecting oft-cited theories that *tabulae navigandi* might refer to copies of the *toleta di marteloio*,[5] and that *mappamundi* in these contexts might refer to ecclesiastical maps like those of Hereford and Ebstorf, rather than nautical maps that depicted the whole known world (e.g. Dulceti's 1339 chart which extends to the Caspian, or the Catalan Atlas).[6] Pujades was more critical of the limitations of his collection of literary works and technical manuals mentioning maps, acknowledging that authors would opt to embellish the mundane, and technical manuals were written to a specific audience, which may not have included those trained in the use of the maps.[7]

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[5] The *toleta di marteloio* was a table of trigonometric calculations used to determine angles of courses without needing to make mathematical calculations. See: Taylor, E. G. R.: *The Haven-Finding Art: A History of Navigation from Odysseus to Captain Cook* (London: Hollis & Carter, 1956). pp. 117-123.

[6] Pujades i Bataller: (2007), p. 441.

[7] Ibid. p. 443.

What is not written in documentary sources is in many ways as important as what is mentioned. Although Pujades' compilation listed numerous post-mortem inventories of sailors and merchants, there was no indication of how many inventories of seafarers he examined which did not include maps. It would be impossible to theorise a ratio, but it seems likely that more inventories did not mention maps than did. In literary sources, nothing can be logically inferred from the lack of cartographic descriptions, even in situations that might have called for them, because they were entirely subjective to the knowledge and intentions of the author.

Literature

There exist numerous literary references to nautical maps and their use, deriving from poetry, prose, encyclopaedias, and technical manuals. A number of them have been discussed by several authors, including Patrick Gautier Dalché, Ramon Pujades i Bataller, and Analisa Conterio.[8] Unfortunately, as Pujades noted, the subjectivity of literary sources for the ownership and use of portolan charts is even more limited than documentary sources: poetry and prose tend towards hyperbole of the interesting and dismissal of the ordinary, with the intention not to give a fully accurate account, but keep the reader's interest. Pujades argued that the same is true of technical literature, though for a different reason: few seamens' manuals (except Benedetto Cotrugli's *De Navigatione*) discussed the use of portolan charts because – according to Pujades – their use in navigation was so commonplace that it did not warrant discussion.[9] However, an alternative explanation could be that the use of charts at sea was not mentioned because it was an esoteric occurance.

The earliest documentary mention of the use of a map at sea is the account of the 1269 expedition of Louis IX to Tunis, as chronicled by Guillaume de Nangis in his *Gesta*

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[8] See: Gautier Dalché, Patrick: 'L'usage des cartes marines aux xiv^{e} e xv^{e} siècles', in *Spazi, tempi, misure e percorsi nell'Europa del Basso medioevo. Atti del Convegno Storico Internazionale*: Todi, 8 - 11 October, 1995. (Spoleto: Centro italiano di studi sull'alto medioevo, 1996), pp. 97-128; Pujades i Bataller: (2007), pp. 443-466; Conterio, Analisa: "L'Arte del navigar'. Cultura, formazione professionale ed esperienze dell'uomo di mare veneziano nel xv secolo', in *L'uomo e il mare nella civiltà occidentale: da Ulisse a Cristoforo Colombo. Atti del convegno*: Genoa, 1-4 June, 1992. (Genoa: Società Ligure di Storia Patria, 1992), pp. 188-225.

[9] Pujades i Bataller: (2007), pp. 443-444.

Sancti Ludovici from c.1270.[10] The chronicle noted that when the ships were unsure of their position and the sailors were in disagreement about where they were, fearing being too close to the shore, "dixerunt enim quod credebant esse prope terram, et multum mirabantur quod tam tarde suis aspectibus appareret. Unde allata mappa mundi, regi situm terrae portus Callarici, et vicinitatem propinqui littoris ostenderunt".[11] This text has often been discussed by scholars of portolan cartography, suggesting that nautical maps existed and were used for navigation at sea some decades earlier than the earliest survivor, the *Carte Pisane*. However, the text does not indicate maps were used regularly at sea; on the contrary it seems they were only used as a last resort in emergency situations.

Other accounts similarly attest to the use of maps as an emergency measure. Milanese nobleman Roberto da Sanseverino described his 1458 voyage to Crete: when no land had been spotted for several days, a council of the ship's officers convened to consult a chart ('*cartezare*') but could not agree on their position: "…niuno di loro fu concordante inseme, perchè chi diceva essere a presso ad l'insula di Candia, et chi in uno modo et chi in un altro".[12] A 1494 account by friar Pietro Casola described that while there had been many charts on board the ship on which he was traveling, none of them served to help when they became lost.[13] These accounts indicate the use of charts in emergency situations when regular navigation was impossible, but also that the charts may not have been all that helpful in some circumstances.

There are accounts that, while attesting to the existence of nautical maps amongst a sailors' repertoire, do not specify how or when they were used. Both Campbell and Pujades

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[10] See: Campbell: (1987), p. 439; Gautier Dalché, Patrick: 'Cartes marines, représentation du littoral et perception de l'espace au Moyen Âge. Un état de la question', in *Zones côtières littorales dans le monde Méditerranéen au moyen âge: défense, peuplement, mise en valeur. Actes du colloque international organisé par l'Ecole française de Rome et la Casa de Velázquez*: Rome, 1996, Castrum 7. (Ecole française de Rome et la Casa de Velázquez, 2001), pp. 9-32. p. 12; Pujades i Bataller: (2007), p. 444.

[11] "… they [the navigators] said they believed to be close to land, and many were bewildered that the horizon had appeared so late to his men. Hence the *mappaemundi* was brought forth, directing the position of the land of the port of Cagliari, and showed the proximity close to the shore." de Nangis, Guillaume: 'Gesta Sancti Ludovici (c.1270)', in *Historiae Francorum ab Anno Christi DCCCC ad Anno MCCLXXXV* (Frankfurt: Apud Andreae Wecheli heredes Claudium Marnium & Ioannem Aubrium, 1596). <http://digitale.bibliothek.uni-halle.de/vd16/content/pageview/2637745> [accessed 14 January 2014], pp. 400-470. p. 461.

[12] Personal Translation: "… none of them were together in agreement, because there were those who claimed to be near the island of Crete, and some in one manner and some in another". Transcription found in: Pujades i Bataller: (2007), p. 445, and Gautier Dalché: (1996), pp. 114-115.

[13] "Per més cartes nàutiques que n'hi havia a bord no servien de cap ajuda". Pujades i Bataller: (2007), p. 446. Translation: "Though there were many nautical charts on board, none served any help".

mentioned the early fourteenth-century *Documenti d'amore* by Francesco de Barberino, which indicated the use of charts, lodestone, and hourglass amongst sailors' aides.[14] However, Barberino did not elucidate how maps were used, for what purpose, or how often. Contrastingly, some accounts were rather specific: for example, the German cleric Felix Faber d'Ulm wrote in his late-fifteenth-century itinerary of his amazement at the navigators using the chart:

> "In illa charta perpendunt et vident ubi sunt, etiam dum nullum [*sic*] teram [*sic*] conspicere potest, et dum nec sidera apparent propter nebulas. Hoc autem inveniunt in charta ducendo circulum de linea ad lineam de punctis ad punctum mirabili industria: multa alia instrumenta habent, in quibus maris itinera considerant, et cottidie simul sedent de his conferentes".[15]

Taken literally, it might seem from Faber's account that maps were used daily. However, it is also entirely possible that he witnessed the use of a map once, and that many of the ship's officers' daily meetings went without consultation of a chart, but he embellished his account for the fascination of his readers. Certainly a reverence was held for portolan maps and the information they contained: an account of Opicino di Canistris, who worked at the papal court in Avignon, included the following words: "Nunquam vidi fieri mappas maris, nec curavi videre, eo quod ignorancia mea non permittebat me talia scire".[16]

The *História do descobrimento e conquista da Índia pelos portugueses* by Fernão Lopes de Castanheda, published in Coimbra from 1551, recounted that a chart was given to the explorers looking to find a sea-passage to India during the reign of King John II of Portugal (1481-1495). Because those seas were unknown, the "Sea Carde … was taken out of a Mape of the whole worlde, by a Maister of Arte, called Calsadilla, Bishoppe of Vyseu,

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[14] Discussed in Campbell: (1987), p. 441; Excerpt of text provided by: Pujades i Bataller: (2007), p. 444.

[15] "On that same chart, they assess and look at where they are, even when no land is able to be seen, and while no stars appear because of the clouds. This, however, they find on the chart by drawing a circle from line to line, from point to point in wonderful industry: they have many other tools, in which they consider the ways of the sea, and at the same time every day they sit and confer about these things." Transcription in: Ibid. p. 446. Discussed by: Campbell: (1987), p. 443, and Pujades i Bataller: (2007), p. 459.

[16] "I never made maps of the sea, nor took care to see, because of my ignorance I was never entrusted to know such things". Text found in: Ibid. p. 444.

who was a good Astronomer".[17] The book went on to discuss how new lands, seas, and ports were added to the chart, and how they informed the king that the land on the map which belonged to Prester John was actually that of the King of Ethiopia. Although literary prose, and certainly embellished, the references to the map indicate another important role portolan maps played in the era of discovery: to be amended and annotated during voyages of discovery and brought back to depict a more accurate image of the world.

Occasionally, poetry mentioned portolan maps, often in an abstract way: Florentine merchant Gregorio Dati (1362-1465) used the image of the nautical chart in an imaginative way to illustrate the changing fortunes of everyone from wealthy merchants to pirates in his popular cosmological poem *La Sfera*: "Ecco la carta dove son segnati / I venti e porti e tutta la marina / Vano per mar mercatanti e pirati / Quei per guadagni e questi per rapina. / Et in un puncto richi o sventurati / Sono ale volte da sera o da mattina / Che la fortuna in alcuna altra cosa / Non si dimonstra tanto ruinosa".[18] Pujades discussed this excerpt, along with another fifteenth-century poem by Catalan Ausiàs March – "Ell va de nit sens brúxola or carta; menys de pilot en la canal de Flandes", and wrote that they, along with other poetic references to charts, demonstrated the permeation of nautical cartography into the wider culture, which in turn suggests they were commonplace.[19] However, this same cultural penetration might have been accomplished through maps with aesthetic and scholarly purposes: in no way does it confirm a primarily utilitarian function.

Technical Manuals

One might expect that technical manuals and scholarly treatises about seafaring would be excellent sources of information about portolan charts, especially if they were a vital and commonplace tool used by navigators. However, there is a near-complete lack of discussion of maps in technical manuals from the thirteenth through fifteenth centuries. This highly unusual void has been questioned by many. Both Gautier Dalché and Falchetta

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[17] Lopes de Cantanheda, Fernão: *The Historie of the Discoverie and Conquest of the East Indias*, trans. by N. L. Gentleman (London: Thomas East, 1582). <http://gateway.proquest.com.ezphost.dur.ac.uk/openurl?ctx_ver=Z39.88-2003&res_id=xri:eebo&rft_id=xri:eebo:image:9295> [accessed 16 January 2014], p. 2.

[18] Dati, Gregorio: *La Sfera* (Venice: Gabriele di Pietro, c.1475). <http://lcweb2.loc.gov/cgi-bin/ampage?collId=rbc3&fileName=rbc0001_2003incun77411page.db> [accessed 14 January 2014], p. 19.

[19] Pujades i Bataller: (2007), p. 459.

noted the odd fact that there existed only one known pre-sixteenth-century guide that described the use of a navigational chart: the *De Navigatione* of fifteenth-century Ragusan merchant Benedetto Cotrugli, which was written in the second half of the fifteenth century and never published or disseminated.[20] Other manuals existed which did not mention the existence of charts, including: Michele da Rodi's personal manuscript, begun in 1434, which detailed methods of navigation; Pietro di Versi's *Raxion de marineri* from 1445, which detailed many subjects of the quadrivium and included a written portolan; and Zorzi da Modone's 'Trombetta' manuscript, finished in 1449, which detailed shipbuilding, navigation, and sailing technique amongst other eclectic interests.[21]

Falchetta's explanation was that Cotrugli's *De Navigatione* was an exception amongst technical manuals because it synthesized both the theoretical and the practical, whereas others like those of Michele da Rodi or Zorzi da Modone were only the latter. Purely technical manuals could not explain rules for the charts' use without knowing "their relative exactness", whereas Cotrugli's theoretical knowledge allowed him to synthesise general rules for their use.[22] Pujades posited a slightly different explanation to Falchetta, reasoning that many manuscripts and others did not discuss the use of charts because their contents were more academic and theoretical, and something as commonplace as using a chart would not have been of interest.[23] However, both explanations seem doubtful: Michele da Rodi's manuscript, for instance, concerned the use of the *raxon de marteloio*, which concerned trigonometry and how to navigate mentally. Yet, an integral part of this navigation process – if the proponents of a functional utility are to be believed – was the use of a chart. That da Rodi never once alluded to maps is odd, because had they been a part of standard appurtenances, one would expect a brief note at the very least, if not an full explanation.[24]

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[20] New Haven: BRBML, MS. 557. See: Gautier Dalché: (2001), p. 24; Falchetta, Piero: 'The Use of Portolan Charts in European Navigation During the Middle Ages', in *Europa im Weltbild des Mittelalters: Kartographische Konzepte*: Nuremburg, 15-17 June 2006, ed. by Ingrid Baumgärtner and Hartmut Kugler. (Berlin: Akademie Verlag, 2008), pp. 269-276. pp. 271-272. A discussion of the practice of navigation according to Cotrugli is found in Chapter IV, Part I, but in brief, a navigator could determine his current position by knowing which direction and the estimated distance he had sailed since the last measurements were taken.

[21] Ibid. p. 272.

[22] Ibid. p. 276.

[23] Pujades i Bataller: (2007), p. 443.

[24] Dibner Institute for the History of Science and Technology: 'Michael of Rhodes: Manuscript Viewer', (2005) <http://brunelleschi.imss.fi.it/michaelofrhodes/manuscript.html> [accessed 4 December 2013]. ff. 46v-48r.

In the sixteenth and seventeenth centuries, a great number of practical guides for mariners were published, some of which did discuss the use of nautical maps. One of the most disseminated works was the *Arte de Navigar* by Martín Cortés, previously discussed in Chapter I in relation to its unique and highly informative description of the process for copying a nautical map. First published in Seville in 1551, the *Arte de Navigar* became incredibly popular, was translated into a number of languages, and published in several editions into the seventeenth-century. Cortés was an advocate of the use of the marine chart: "la mejor explicacion que para esto han hallado los ingenios delos hombres es dar lo pintado en una carta".[25] Later, Cortés described the method for 'taking point' ('echar punto') during navigation, which was almost identical to that described by Cotrugli. Cortés wrote that the pilot must first know the latitude of departure and the wind (direction) sailed, and after checking ones' current latitude, could use two dividers to measure and estimate the current position of the ship. However, he remarked that "… ha se de tener respecto alos vientos y mareas y otras cosas que la experiencia les muestra, para saber si han caminado derechamente por aquel rumbo, o si han de caydo y a qual parte del: Lo qual remito a los buenos juizios delos experimentados."[26] Unfortunately, Cortés did not mention at any time how often charts were to be used in navigation, and from this last statement, it can be inferred that having a chart was only an addition to, not a substitute for, knowledge and experience of seafaring.

Another sixteenth-century nautical treatise which discussed the methods of navigation was the *Arte de Navegar* by Pedro de Medina, which was first published in Valladolid in 1545, translated into several languages and reprinted in many editions. Medina, like Cortés, noted the importance of a chart: "among the Instruments which are necessary for the Nauigation, one is the Carde, for without it good nauigation cannot be made."[27] Medina explained the methods of navigation using a chart, and its problems because the earth was spherical, whereas the chart was flat ('plaine'). He also warned

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[25] "The best invention that has been found from the wits of men is to provide this [information] painted on a chart." Cortés, Martín de Albacar: *Breve Compendio de la Esfera y del Arte de Navigar* (Seville, 1551). <http://documentomovil.usal.es/visor.php?f=nautica_bg_CortesAlbacar&v=dicter&p=1> [accessed 22 January 2013], f. 52r.

[26] "[Navigators] must have respect for the winds and seas and other things that experience has shown, in order to know if they have travelled directly by that rhumb, or if they have fallen from it and by how much: which I refer to the judgement of the experienced." Ibid. f. 89v.

[27] de Medina, Pedro: *The Arte of Navigation*, trans. by John Frampton (London: Thomas Dawson, 1595). p. 16.

against the use of charts which showed two latitude scales, saying that this was an indication they were inaccurate.[28]

The *Nautica Mediterranea*, published in Rome in 1602 by Bartolomeo Crescentio (discussed in Chapter I), included a section which discussed methods of navigation. Crescentio wrote that there were two methods: one used by pilots within the Mediterranean which did not take latitude into account, and another used in the oceans.[29] The methods however, were similar to those discussed by Cotrugli, Cortés, and de Medina above: the navigator needed to know his speed, direction traveled, and the duration of time since departure (or last point).

A. E. Stephens discussed a little-known manuscript manual in the British Library: Add. MS. 37024. The anonymous codex, entitled *Book of the Sea Carte*, is undated but certainly dates to the sixteenth-century.[30] The manual, like many of the time, incorporated the practical knowledge of the conservative practices of seamen, with the theoretical knowledge of scholars. Included within the book are rutters for the Northern Atlantic and North Sea, explanations of the tides, guides to the use of various instruments and astronomy, and four small portolan charts of the British Isles and Flanders. Hewson noted that the manual was meant to be used as a rutter, and the maps were illustrative and not for navigation.[31]

The nineteenth chapter of William Bourne's 1574 nautical manual – *The Regiment for the Sea* – discussed the use of charts as well. In the text, Bourne made the following complaint: "I would wish the<u>m</u> that be the makers of plats and cardes for the Sea, not to paint their compasses with so many colours: neither upon the Lande with so many flagges, for that it dothe rather hurte than good."[32] This statement indicates that not only did navigators use charts, but that these charts were at least sometimes decorated. Although this might seem to cast doubt on the theory that ships' pilots only used inexpensive undecorated maps, the percentage of surviving charts and atlases which were unadorned

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[28] Ibid. pp. 28-29.

[29] Crescentio, Bartolomeo: *Navtica Mediterranea* (Rome: Bartolomeo Bonfadino, 1602). <http://gallica.bnf.fr/ark:/12148/bpt6k51038x/f2.image.r=nautica%20mediterranea.langEN> [accessed 24 January 2013], pp. 191-208.

[30] Stephens, A. E.: '"The Booke of the Sea Carte": A Seaman's Manual of the Sixteenth Century', *Imago Mundi*, 2 (1937), 55-59.

[31] Hewson, J. B. : *A History of the Practice of Navigation*, 2nd edn. (1951; repr. Glasgow: Brown, Son & Ferguson Ltd., 1983). pp. 19-20. A transcription of the text could not be found.

[32] Bourne, William: *A Regiment for the Sea* (London: Thomas Hacket, 1574). p. 49.

seems to have fallen from perhaps forty percent in the fifteenth century to as little as ten percent by the late sixteenth century. Lavish and even gaudy ornamentation seems to have become popular in the later decades of the genre.

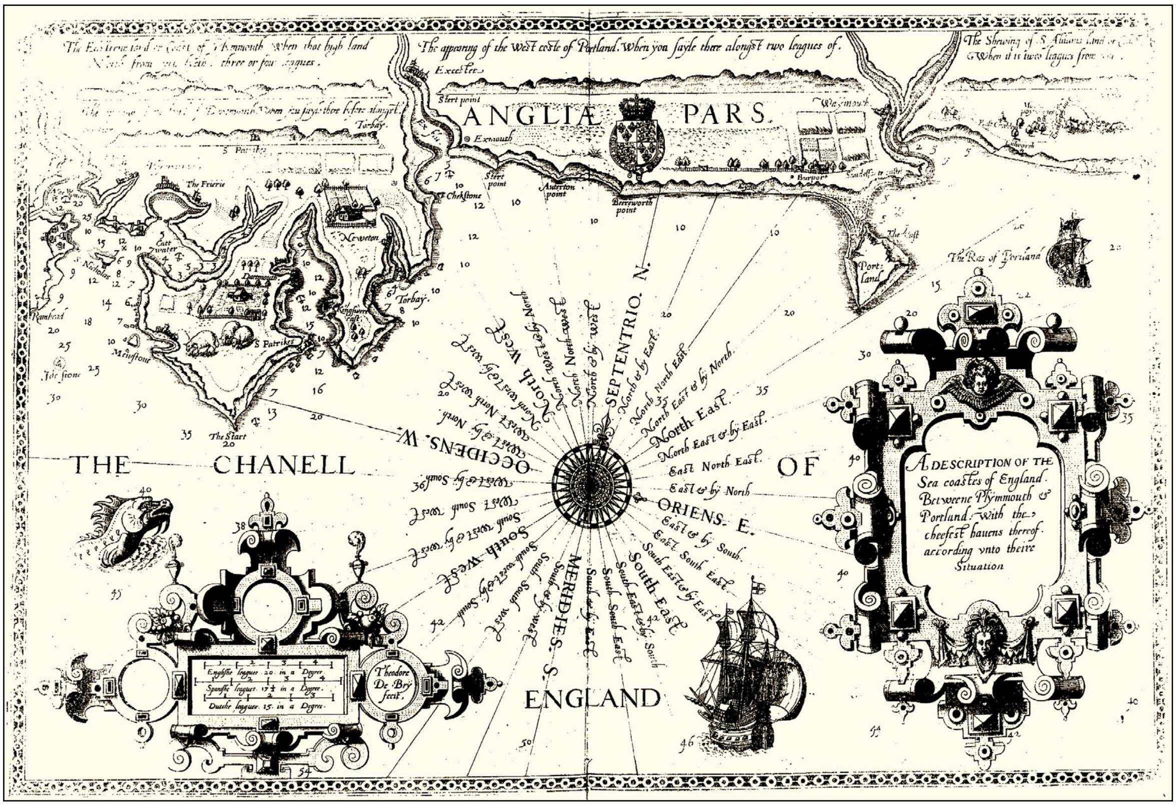

Figure 3.1: A chart of the south English coast between Plymouth and Weymouth from Waghenaer's *The Mariner's Mirrour* (London: 1588). pp. 118-119. Note how much larger the scale is in comparison to regular portolan maps. Image from Early English Books Online: <http://gateway.proquest.com.ezphost.dur.ac.uk/openurl?ctx_ver=Z39.88-2003&res_id=xri:eebo&rft_id=xri:eebo:image:23119:66> [Accessed 9 February 2014].

In 1583, the Dutch navigator and cartographer Lucas Janszoon Waghenaer published a printed treatise on navigation entitled *The Mariner's Mirrour*, which included a series of nautical charts of the Atlantic on plane projection. Hewson discussed the popularity of the manual amongst Dutch and English navigators, who, with the growing threat of Spanish naval power, were keen to find any technical advantage.[33] In the 1588 English edition of the text, Waghenaer included in his 'Author's Admonition to the Reader' that "I was enformed by many Pilots of good credit, with how great good-liking the Sea-Cardes were receaued in many other countries & kingdoms".[34] However, only one map was

[33] Hewson: (1983), p. 22.

[34] Waghenaer, Lucas Janszoon: *The Mariners Mirrour*, trans. by Anthony Ashley (London: [Unknown], 1588). <http://gateway.proquest.com.ezphost.dur.ac.uk/openurl?ctx_ver=Z39.88-2003&res_id=xri:eebo&rft_id=xri:eebo:image:23119:4> [accessed 25 January 2014], p. 3.

Figure 3.2: The only 'portolan chart' included in Waghenaer's *The Mariner's Mirrour* (London: 1588). pp. 38-39. Image from Early English Books Online: <http://gateway.proquest.com.ezphost.dur.ac.uk/openurl?ctx_ver=Z39.88-2003&res_id=xri:eebo&rft_id=xri:eebo:image:23119:26> [Accessed 9 February 2014].

included that may be called a portolan chart; the others printed were on a much larger scale, included soundings, panoramas of the coastline from the perspective of ships, and were on a plane projection. Although related maps, the charts Waghenaer included for use in navigation were a genre descendant from portolan maps, but not portolan maps themselves.

The literary references to portolan maps would seem to suggest that they were used at sea, either in emergencies, or to 'take point' whereby distance and direction were measured to calculate the ship's current position.[35] Indeed, from an examination of these sources, it is no wonder that many scholars have theorised that portolan maps were used for navigation. Yet, there are several peculiarities and problems with the documents; why for instance, was Cotrugli's the only pre-sixteenth-century manual that described charts being used for navigation? Moreover, it must be remembered that poetry and narrative prose often chose to embellish and exaggerate some aspects, and dismiss others, rather than provide a balanced objective description. The same could be true of technical manuals, many of which were not actually written for the education of ordinary sailors, but for the upper classes who had taken a scholarly and/or financial interest in seafaring and exploration, especially in the sixteenth and seventeenth centuries. Although many of the literary sources seem to propound a navigational function for portolan maps, the examination of the practicalities discussed in Chapter IV indicate instead that the maps could not have been all that useful.

Ownership

The ownership of maps in the medieval and early-modern period is unfortunately a poorly-understood area within the history of cartography, as Catherine Delano-Smith commented.[36] However, demographics of portolan chart ownership may be determined from many sources, including: the charts themselves, if they include a written dedication or armorial of the recipient; bills of sale, contracts of commission, and legal proceedings that reference maps; and inventories that include maps. By knowing who map owners were, their function and purpose can be surmised. However, deduction of function based on ownership is also problematic: a chart listed among the possessions of a deceased pilot,

[35] The exact method of navigation will be discussed in Chapter IV.

[36] Smith, Catherine Delano: 'Map Ownership in Sixteenth-Century Cambridge: The Evidence of Probate Inventories', *Imago Mundi*, 47 (1995), 67-93. p. 67.

even if accompanied by a magnetic compass, dividers, and other devices associated with navigation, does not necessarily prove that the map had anything to do with navigating. The map might instead have been a memento the mariner obtained, perhaps in retirement or to display in his home. Additionally limiting is the fact that documents from which possession is stated or inferred are not necessarily equally representative of all owners. More will have been written about maps of great value made for prominent members of society than simple inexpensive charts, and in terms of contracts, verbal agreements leaving no historical record were regrettably common, as Tony Campbell pointed out.[37] Any conclusions drawn must be aware of this bias in the evidence.

The ownership of portolan charts between the late thirteenth century and 1500, as indicated by the evidence, shows a varied range of socio-economic owners. Only half of Pujades' compilation of documents specified the occupation of the owner, from which he calculated the following distribution of ownership in three main categories. First were those whose profession involved the sea: twenty-seven boatswains, navigators, and general seamen, seventeen ships' captains and skippers, five shipwrights and caulkers, two ships' scribes and one fisherman. Second were those landsmen with a more eclectic or academic interest: five practitioners of medicine, five notaries, five clergymen, five nobles, knights, and squires, "a number of sovereigns and princes"[38] (which total eleven), one cooper, one blacksmith, one artist, and one converted Jewish tax-collector. Finally was the largest single group of all, thirty-two merchants.[39]

Others can be added to these figures from additional sources, including the previously discussed Papal nuncio Prospero Camulius de Medici for whom the 1468 Benincasa atlas was made. Campbell discussed a number of known and presumed owners in his 1987 chapter; although the map has not survived, there is evidence that King Henry VII was presented with a chart by cartographer Bartolomeo Colombo on 13 February 1488.[40] An armorial on the 1426 Batista Becharius chart indicates it was probably made for the King of Castile – John II – who reigned from 1406 to 1454. Additionally, the

[37] Campbell: (1987), pp. 435-436.

[38] Pujades did not supply a number of royals who owned maps, but the kings and princes named or deduced from his compilation were: King James II of Aragon (1267-1327), Phillip VI of France (1293-1350), Charles IV of France (1294-1328), James III of Majorca (1315-1349), Peter IV of Aragon (1319-1387), Charles V of France (1338-1380), Frederick III of Sicily (1341-1377), John I of Aragon (1350-1396), Martin I of Aragon (1356-1410), Charles III of Navarre (1387-1425), and Alfonso V of Aragon (1396-1458).

[39] Pujades i Bataller: (2007), p. 452.

[40] Campbell: (1987), p. 375, (note 38).

Bartolomeo Pareto chart of 1455 was likely made for Pope Nicholas V, while Cardinal Riario was the owner of a 1482 Benincasa atlas. Written on a Jehuda Ben Zara chart was the deposition of the Sultan of Cairo to purchase the map, dated 8 February 1497.[41] Campbell also suggested that coats of arms imprinted on atlas bindings may serve to identify ownership: two surviving atlases were owned by the wealthy patrician Cornaro family of Venice, and other atlases have been identified as having been owned by the prominent Genoese Usodimare family, and Borso d'Este (1413-1471), the first Duke of Ferrara.[42]

Figure 3.3: Distribution of Portolan Chart Ownership 1300-1500

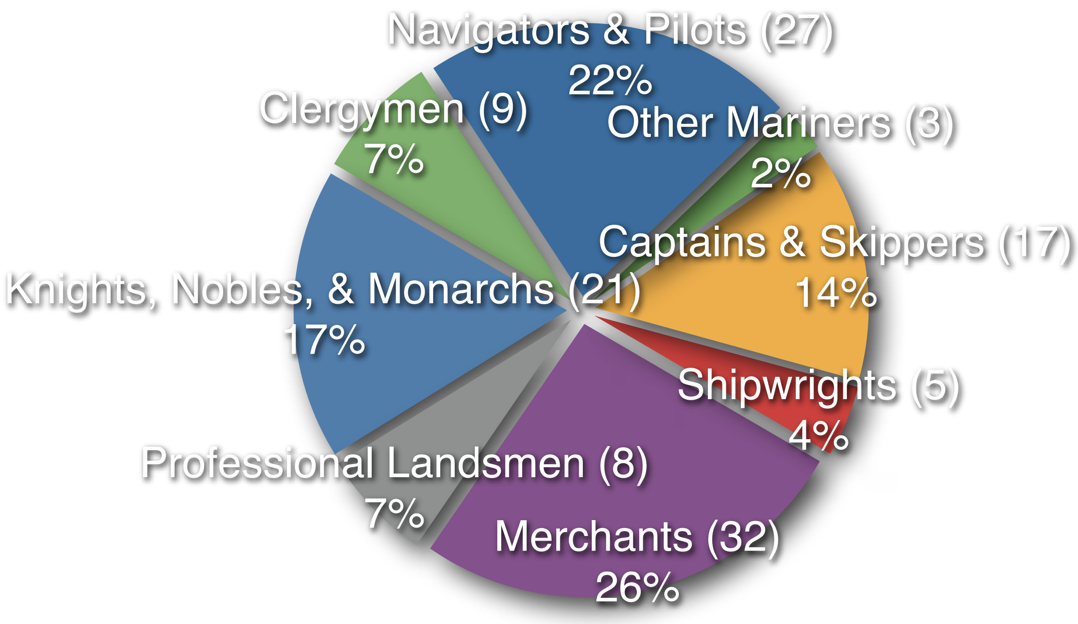

Figure 3.3 graphs the different sorts of owners as determined by the data discussed above, and it almost certainly over-represents the wealthy and elite members of society who owned luxurious and expensive maps, because those maps were more likely to have been the subject of documented evidence, and had a greater chance of survival. Nevertheless, it shows that owners who might have used their maps for the purposes of navigation were only one of a number of different socio-professional categories. Even amongst the mariners who represent roughly a third of the owners, it is a logical fallacy to conclude that because a pilot of a ship owned a portolan chart, that chart was used to pilot the ship. Its function could instead have been decorative, to promote one's prestige and erudition, as a memoir of time spent at sea, or as a more general geographical or educational reference.

[41] Ibid. p. 435.

[42] Ibid.

Pujades discussed the socio-professional distribution, and argued that in many cases, even landsmen might be occasional seafarers who would have need of a chart while at sea.[43] Considering merchants, the largest single grouping of owners, he argued that during the late Middle Ages, most would have been well-acquainted with the sea and potentially in navigational practice, and in several circumstances had possibly been skippers earlier in life. Three of his documents indicated merchants had carried charts with them on trading voyages.[44] Nevertheless, there is no direct evidence that those charts owned by merchants were used for navigation; Benedetto Cotrugli wrote in his *Libro dell'Arte di Mercatura*, "Et più li bisogna sapere le distantie, li siti, porti e piaggie, et molto bene la carta di navicare, per sapere noliggiare et assicurare", which demonstrates that merchants used maps to plan voyages and trading ventures.[45]

Regarding notaries and landed professionals, Pujades surmised that if the charts were used in their profession as geographic references for legal proceedings, many more would have survived and been identified to this effect, and instead suggested they might have been purchased simply as scrap parchment, or to be used in bindings or repairs.[46] However, it is still possible that notaries did use charts as geographic references on an everyday basis, but that they were not personally owned, and instead the property of the greater office, whether the city authority, church, university etc., and might thus have been amongst the hundreds of portolan maps of which there is no evidence of ownership.

Finally, concerning possession by the more elite members of society – knights, nobles, princes, and clergymen – Pujades acknowledged that some maps would have been purchased for cultural and scholarly interest and to enhance social status, but also pointed out that many knights and nobles engaged in seafaring, and argued that elite ownership by no means precluded their navigational utility.[47] Pujades' overall conclusion about the patterns of ownership of portolan charts was that "possession of portolan charts and the

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[43] Pujades cited a piece of medieval Catalan legislation which suggested that all 'nauxers' (naval officers) needed to master a number of navigational techniques or face penalties, though nowhere in the quote was any reference to the use of a chart. The cited text was found in the *Llibre de Consolat de Mar*, a compendium of Catalan and later Aragonese naval laws, first began in the 1320s. See: Pujades i Bataller: (2007), p. 452 (note 3).

[44] Ibid. pp. 452-453.

[45] "And they [merchants] need to know distances, sites, ports, and shores, and the charts very well, in order to charter and to insure [ships]". Cotrugli, Benedetto: *Il Libro dell'Arte di Mercatura*, ed. by Ugo Tucci (1468; repr. Venice: Arsenale, 1990). p. 213.

[46] Pujades i Bataller: (2007), p. 453.

[47] Ibid. p. 454.

practice of navigation, despite what some people say, were two inseparable phenomena in the medieval Western Mediterranean."[48] However, the evidence is entirely inconclusive: portolan maps were owned by a wide range of people of various professions, and though indisputably most of these people had an interest in the sea, no evidence derived from ownership patterns suggests that the maps were used for navigation. Indeed, as was shown in the case study in Chapter II, the *Liber secretorum* atlases made by Petrus Vesconte were disseminated around Europe to help promote his crusade, and to aid military planning, not to be used on board a ship for navigating.

Despite more sixteenth and seventeenth-century portolan charts having survived, less is known about their ownership. The majority of scholarship on portolan maps has concerned the earlier charts and atlases made before the discovery of the New World. However, Corradino Astengo discussed the ownership of later portolan maps in his 2007 chapter, but most of what is known is related to expensive decorated charts and atlases owned by wealthy and elite patrons. No scholar has yet attempted to systematically scour numerous European archives in order to compile a much more thorough set of documentary evidence for the sixteenth and seventeenth centuries as Pujades did for the later medieval period, but undoubtedly this would prove extremely useful. As a result, it is not appropriate to graph percentages of different users, because it would be mostly dominated by knights, nobles, monarchs and clergy, with only a handful of others.

One individual study by Catherine Delano-Smith of the probate inventories of sixteenth-century Cambridge revealed significant evidence of map ownership in Tudor England, including a few possible portolan maps. The most valuable item from the 1546 inventory inventory of bookseller N. Pilgrim was a 'carta marina', valued at 3s 4d. Although most likely a copy of Olaus Magnus' *Carta marina et descriptio*…, it might have been a portolan chart or atlas.[49] Edward Raven, a fellow of St John's College and practitioner of medicine, was an avid collector of maps; his inventory from 1558/9 included "a grete mappe begynnyng carta marina", valued at 6s 8d, and from the context, Delano-Smith noted was likely a wall-map, possibly a portolan chart.[50] The substantial 1589 inventory of Andrew Perne, Cambridge University vice-chancellor and master of Peterhouse College, listed over thirty maps and atlases, including a first edition copy of

[48] Ibid. pp. 455-456.

[49] Smith: (1995), pp. 82, 88.

[50] Ibid. pp. 83, 89.

Waldseemuller's 1516 *Carta Marina Navigatoria*, valued at 3s 4d.[51] Although printed and not strictly a portolan chart, it nevertheless demonstrates the interest that existed in nautical cartography. Although Delano-Smith's study did not reveal any portolan maps with certainty, many of the inventories were vague, only listing 'small map' or 'old map' etc. The study remains nonetheless a valuable demonstration of the importance of inventories to explore patterns of map ownership.

Sixteenth and seventeenth-century owners of portolan maps have been identified through various means. From coats of arms painted on many of Battista Agnese's (fl. 1536-1564) atlases, numerous owners are known. Amongst royal owners, one atlas from the mid-sixteenth century contains a cartouche with a dedication to Henry VIII;[52] a second Agnese atlas, originally owned by Sebastian von Heusenstamm, Archbishop of Mainz, was owned almost a century after its creation by Christina, Queen of Sweden (1632-1654);[53] another includes the arms of the Holy Roman Emperor Charles V;[54] and a fourth Agnese atlas contains a portrait of him, the arms of Castile and Aragon, and the inscription: "Philippo Caroli Aug. F. optimo princ. Providentia", which Astengo suggested indicates it was a gift from Charles to his son Philip.[55]

Numerous prominent nobles owned portolan maps, most often identified through coats of arms: Cosimo I de Medici, Giovanni Andrea Doria, Alfonso II d'Este, the Duke of Wolfenbüttel, Gaspard II de Coligny the Seigneur de Châtillon, and Charles Howard, 1st Earl of Nottingham and the Lord High Admiral under Elizabeth I and James I.[56] B. van 't Hoff noted that Jan van Dovenvoorde, Seigneur of Warmond, Esselickerwoude and Alkemade (1547-1610), owned a 1533 portolan chart by Jacobus Russus of Messina.[57] Astengo additionally identified many portolan maps having belonged to numerous noble families, including the Venetian Emo family, the Medici, the Colonna, the Sommaja, Tron,

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[51] Ibid. pp. 85, 90.

[52] Rome: BAV, Barb. Lat. 4357. See: Wagner, Henry R.: 'The Manuscript Atlases of Battista Agnese', *Papers of the Bibliographical Society of America*, 25 (1931), 1-100. pp. 77-78.

[53] See: Astengo, Corradino: 'The Renaissance Chart Tradition in the Mediterranean', in *The History of Cartography*, ed. by David Woodward, 3 vols. (Chicago: UCP, 2007), vol. 3, pp. 174-262. pp. 181-182 & Wagner: (1931), pp. 87-88.

[54] Privately owned by the Rothschild family. See: Ibid. pp. 61-62.

[55] Providence: JCBL, 1-SIZE Z Codex 3. See: Astengo: (2007), p. 178 & Wagner: (1931), p. 74.

[56] Astengo: (2007), pp. 178-180, 182.

[57] van 't Hoff, B.: 'A Portolano by Jacobus Russus from Messina in the Possession of Jan van Duivenvoorde', *Oud Holland*, 75: 1 (1960), 106-107. pp. 106-107.

and Hohenlohe-Neuenstein families.[58] As discussed in the case study in Chapter II, the four charts including the 1567 Jacopo Maggiolo regional map were likely owned by a Knight of Saint Stephen.[59] A number of clerics owned portolan charts and atlases as well. Wagner concluded a c.1545 ten-map Agnese atlas belonged to Cardinal Barberini.[60] The 1447 Valseca chart was at one time owned by Cardinal Francesco de Lauria, who lived from 1612 to 1693.[61] Astengo noted other owners including Cardinal Guido Ascanio Sforza, the aforementioned Archbishop of Mainz, the Archdeacon of Cologne, and Cardinal Richelieu.[62]

Astengo discussed the comparatively few pieces of evidence of portolan map ownership in the later centuries by seafarers. These include an anonymous seventeenth-century chart which belonged to 'ship-master' Giovanni Battista Montanaro, and another (probably) sixteenth-century anonymous chart dated in the possession of "captain Clemente Corsamino D'arbisola" in 1603, which later belonged to seafarer Guglielmo Ludovico Porta, whom Astengo noted travelled the Mediterranean between 1674 and 1680.[63] A sixteenth-century atlas attributed to Joan Martines at the British Library (Add. MS 10134) contains an inscription indicating it was owned by Greek pilot Nicolo Canachi.[64] Although owned by seafarers, Astengo pointed out that these three examples were expensive high-quality portolan maps and were certainly not taken to sea.[65] Amerigo Vespucci is thought to have been a later owner of the luxurious 1439 Valseca chart, for which he paid 130 *ducats*.[66] From what can be gleaned from evidence of ownership, like the fourteenth and fifteenth-centuries, there is no direct evidence of utilitarian charts in either the sixteenth or seventeenth-centuries.

It is unlikely (though not impossible) that the aforementioned maps were used decades or even centuries after their construction for the same initial purpose for which they were made. Although in most cases it is impossible to trace the full provenance of a

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58 Astengo: (2007), p. 179.

59 Ibid. p. 291.

60 Vatican: BAV, Cod. Barb. Lat. 4313. Wagner: (1931), pp. 78-79.

61 Campbell: (1987), p. 435.

62 Astengo: (2007), pp. 178-180.

63 Ibid. p. 181.

64 Ibid.

65 Ibid.

66 Pujades i Bataller, Ramón J.: *La Carta de Gabriel de Valseca de 1439*, trans. by Catalina Gironda Arguimbau (Barcelona: Lumen Artis Ediciones, 2009). p. 358.

portolan map's life-history, the function of a chart or atlas, whatever it had been originally, invariably would have changed over time. Astengo discussed an undated loose atlas sheet by cartographer Bartolomeo Bonomi currently at the Galleria Colonna in Rome, which, the Colonna family has claimed, was used by Admiral Marcantonio Colonna during the battle of Lepanto in 1571. Although Astengo doubted the authenticity of this claim, he suggested that the map had likely been owned by the family since the sixteenth century, and noted that in 1897, a Colonna family member, passionate to promote his ancestors, framed the map, and perhaps even began the claim of its use by Admiral Marcantonio.[67] This is but one example of the use of these maps later in their artefact history. Whatever a portolan map's original function might have been, it would have altered over time to become a family heirloom and objet d'art, reaching a multi-functionality as an antique of incredible monetary, historical and collectable value.

The evidence gleaned from ownership, even taking into account the bias in the evidence, indicates that a number of maps were owned by people who were not regular seafarers. Even considering those maps that were owned by seafarers, there is no direct evidence that the portolan maps they owned were used at sea for navigation. Furthermore, the current evidence suggests that there were even more wealthy and erudite owners in the sixteenth and seventeenth centuries, though until archives have been analysed thoroughly for that time period, this is possibly a biased conclusion. Nevertheless, a considerable number of portolan maps were owned by people who would not have used them at sea.

The Economics of the Portolan Map Trade

The first chapter – Construction and Reconstruction – discussed the pace of the manufacture of a portolan chart. This section aims to elaborate on the economics of the portolan map trade, discussing their prices as gathered from contemporaneous documents, the pace of manufacture, the overall production of maps, and the market that existed. Through a better understanding of this market, the functions of portolan charts can be more readily inferred. Few scholars have discussed these particular aspects in detail, primarily due to the lack of evidence. In 1987, Campbell noted that most of the extant evidence related to the production of more elaborate and expensive maps.[68] Fortunately,

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[67] Astengo: (2007), p. 179.

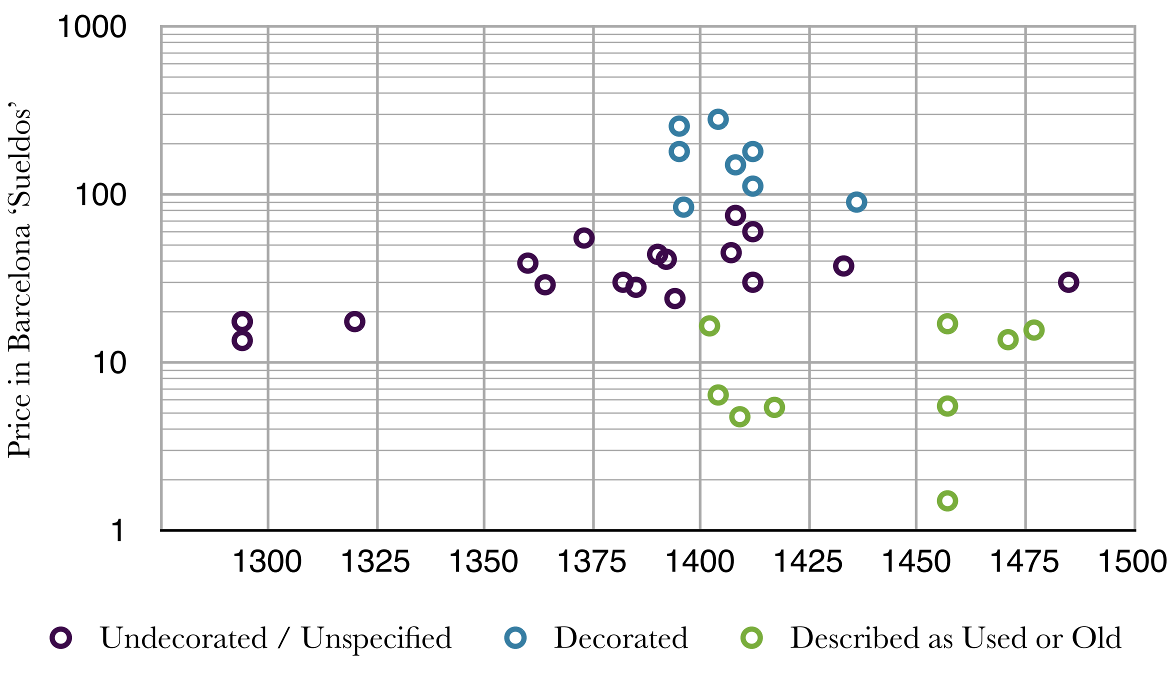
[68] Campbell: (1987), p. 435.

the archival work of Pujades i Bataller has made the discussion possible since his 2007 and 2009 publications. However, the overall conclusion he reached – that "we can certainly speak of serialized, nearly mass production of navigational charts"[69] – is unsustainable for several reasons which will be elucidated.

Prices

In order to evaluate the economics of the portolan map trade, the prices of maps must be established. Regrettably, only a handful of documents have been uncovered that note the price paid for charts, and undoubtedly more archival work would yield great scholarly dividends. Nevertheless, enough information has been published from which a general understanding can be extracted. The following scatterplot depicts all of the known prices paid for portolan maps, generated from information provided by Pujades.[70]

Figure 3.4: Prices Paid for Portolan Charts 1290-1500



[69] Pujades i Bataller: (2009), p. 328.

[70] Pujades i Bataller: (2007), pp. 279-280. The table Pujades provided in his 2007 book converted the different currencies into Barcelona *sueldos* or *sous*, the equivalent of shillings. This was accomplished using Spufford, Peter et al.: *Interim Listing of the Exchange Rates of Medieval Europe* (Keele: University of Keele, 1977). Although it may have been more appropriate to convert all prices to Florentine soldi (the Florin being the most 'international' currency of the time), for the purposes of internal comparison, all prices were left as Barcelona sueldos. Where Pujades gave a range for a particular price conversion, a median value was used.

Unfortunately, no study of portolan charts from the sixteenth and seventeenth-centuries has examined the prices of maps during that period. Thus, while a few references to prices have been found and will be discussed below, there is not enough information to continue the scatterplot beyond 1500. The graph illustrates that there existed a generally fluid range of prices, from inexpensive used charts, to luxuriously decorated maps. In general, three primary groups existed: charts that were described as 'old' or 'used', charts that were presumably undecorated or with only minimal ornamentation, and charts that were described as decorated.

Concerning the least expensive grouping, those that were described as 'old' ('vella'), 'used' ('usada') or in one case – the least expensive chart costing only 1s 6d in 1457 – 'used and small' ('usada petita'), prices ranged from a mere couple of *sueldos*, to seventeen *sueldos* in 1457, a sale which also included dividers. A 1404 purchase in Genoa of a used chart, two charts 'torelas' (possibly defective or discounted), and one pair of dividers was two Genoese pounds and ten shillings (equivalent to thirty Barcelona *sueldos*), but was not plotted on the graph because the whole sale was not itemised.[71]

The second grouping – newer undecorated charts – were the earliest type to be referenced in the documentation, in 1294 in Naples. Three sales of a 'mapamundi', one 'amb sesta' (with dividers), cost the equivalent of 13-18 *sueldos*. Pujades was convinced that despite being identified as *mappaemundi*, these were nautical charts because they were purchased by ships' officers and were associated with dividers.[72] An early sale in 1320 on Majorca cost roughly the same. The plague from 1348-1350 killed between a quarter and a third of the population around much of Mediterranean Europe, the ultimate consequences of which were temporarily increased salaries due to a manpower shortage, and (less temporarily) increased prices.[73] This inflation was certainly reflected in the documentation, whereby the prices of charts seemed to double by the 1360s. On Majorca, the price of a

[71] Pujades i Bataller: (2007), p. 279.

[72] Ibid. p. 499.

[73] Previté-Orton noted that the temporary rise in wages which proceeded to drop again was one of the reasons for added unrest amongst the lower classes. See: Previté-Orton, C. W.: *A History of Europe: From 1198 to 1378* (London: Methuen & Co. Ltd., 1937). p. 345. Kedar suggested that the plague merely accelerated economic problems that had already begun: Kedar, Benjamin Z.: *Merchants in Crisis: Genoese and and Venetian Men of Affairs and the Fourteenth-Century Depression* (New Haven: Yale University Press, 1976). For a further discussion of inflation in Genoa following the plague, see: Epstein, Steven A.: *Genoa & the Genoese* (Chapel Hill, NC: University of North Carolina Press, 1996). pp. 211-219 .

chart with dividers in 1360 was three gold *florins* (roughly thirty-nine *sueldos*), and in 1364, without dividers was two Majorcan pounds (roughly twenty-nine *sueldos*).[74]

Following inflation in the fourteenth-century however, the price of (mostly) undecorated charts appears to have remained relatively stable. In the 1433 contract between Gabriel de Valseca and Jacobo Torella, discussed in Chapter I, the minimum price of each of the twenty-eight charts he was to make to settle his brother's debt was 37½ *sueldos*.[75] Likewise, a chart was sold in 1412 on Majorca for two pounds, or roughly thirty *sueldos*. However, certain factors appeared to have occasionally increased the price: in letters between agents of the Datini in Majorca and Barcelona in 1408, the price of charts seemed to have increased by an entire gold *real* (roughly fifteen *sueldos*) because there was only a single chart-maker on the island: "che altro maestro non c'è che lui."[76] Thus for 1408, the graph depicts the most expensive specifically undecorated chart ("non è depinta le arme delle tere") at the equivalent of seventy-five *sueldos*.

The third group are those charts which were decorated: according to the documents presented by Pujades, these varied widely in price between five Majorcan pounds and twelve shillings (eighty-four *sueldos*), in a 1396 purchase which included dividers and a compass, to 14 Barcelonian pounds (280 *sueldos*) paid for a 'carta de luxe' in Perpignan in 1404 by merchant Francesc Queralt. Without a doubt, the large variability in price depended on the extent of decoration, which is manifested in the surviving corpus of portolan maps. Charts with a moderate amount of decoration – some flags, wind roses, and a city illustration or two, like the reconstructed chart from Chapter I – might fetch double or triple the price of an undecorated map, whereas it could be surmised that the aforementioned 'carta de luxe' included numerous city vignettes, portraits of monarchs, animals, ships, flags, and explanatory texts, and probably a notable application of silver and gold leaf.

Pujades also noted two *mappaemundi* on his list, but these were not included on the scatterplot. The first *mappamundi*, described as being in panels ("tabulas in quibus est figura mundi"), was finished in 1382 for Peter IV of Aragon by Cresques Abraham, and cost 150 Aragonese *florins* (1650 *sueldos*). The second was begun by Cresques Abraham for John I of Castile (r. 1379-1390), but was left unfinished when he died. The king paid sixty Majorcan

[74] Pujades i Bataller: (2009), pp. 279, 499.

[75] Pujades i Bataller: (2007), p. 280.

[76] "That there is no other master than him." Text given in: Ibid. p. 436.

pounds to Jafudà Cresques in 1387 for completing the work, the equivalent of 1,600 *sueldos*.[77] Although Abraham and Jafudà were known portolan chart-makers, there is no indication whether these *mappaemundi* were similar to Abraham's earlier Catalan Atlas (c. 1375), or more like the Hereford or Ebstorf world maps. Similarly, although all but one of the maps were never completed, documents pertaining to the 1399 contract between Franciscus Becharius and Baldassare degli Ubriachi indicated that the total price for four *mappaemundi* was 320 Aragonese *florins*, the equivalent of 3,520 *sueldos*.[78] Two of the maps were to measure sixteen palms by seven and a half palms (300 cm by 136 cm) costing sixty *florins* each, and two others were to measure nineteen palms (370 cm) in both directions costing 100 *florins* each.[79] Given the dimensions, it can be assumed the latter two were more like the Hereford or Ebstorf *mappamundi*, but it might have been the intention for the first two to be similar to the Catalan atlas in content and layout.

Little has been published concerning the price of manuscript portolan charts in the sixteenth and seventeenth centuries. Astengo, in his 2007 chapter, did not include any study of prices, despite a thorough discussion of ownership. In a similar fashion, many studies of map ownership at the time have focused on the study of printed maps without reference to manuscript charts, including Carton's thesis: *Worldly Consumers: The Demand for Maps in Renaissance Italy*, and Koeman's article: *The Chart Trade in Europe from its Origin to Modern Times*.[80] Tyacke discussed the market for both manuscript and printed maps in early modern England, and suggested English manuscript chart-making was seemingly a part-time activity: "hardly a market which drove commercial production".[81] Although there exists some documentation of ownership of maps in inventories (many from Oxford and Cambridge), there is little evidence concerning their price.[82]

Nevertheless, the prices of early modern printed maps may provide a useful context by which to compare and extrapolate the prices of portolan charts and atlases. Already discussed

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[77] Ibid. pp. 279, 435.

[78] Skelton, R. A.: 'A Contract for World Maps at Barcelona, 1399-1400', *Imago Mundi*, 22 (1968), 107-113. p. 108 Conversion made using: Spufford et al.: (1977), p. 189.

[79] Skelton: (1968), p. 108.

[80] Carlton, Genevieve: 'Worldly Consumers: The Demand for Maps in Renaissance Italy' (Doctoral Thesis, Northwestern University, 2011); Koeman, C.: 'The Chart Trade in Europe from its Origin to Modern Times', *Terrae Incognitae: Annals of the Society for the History of Discoveries*, 12 (1980), 49-64.

[81] Tyacke, Sarah: 'Lecture III: There are maps and there are maps - motives, markets and users', Sandars Lectures 2007: Conversations with Maps, (2007) <http://www.lib.cam.ac.uk/sandars/tyacke3.pdf> [accessed 28 June 2010], pp. 5, 16.

[82] Ibid. pp. 17-18.

were the probate inventories of sixteenth-century Cambridge studied by Catherine Delano-Smith, of which three nautical maps (most likely printed) included: a 'carta marina', valued at 3s 4d; a 'grete mappe begynnyng carta marina', valued at 6s 8d; and a copy of Waldseemüller's 1516 *Carta Marina Navigatoria*, valued at 3s 4d.[83] The maps in the inventories ranged from being valued at only a couple of pence, to a twenty-shilling map of England by Waldseemüller. Tyacke noted that in the late sixteenth-century, a printed folio map might cost around 12 pence in London.[84] Carlton discussed a 1528 inventory taken of a Florentine print shop following the death of Alessandro Rosselli, son of the famous engraver and miniaturist Francesco Rosselli. Fifty-eight maps were listed in the inventory, which regrettably was not reproduced in the thesis, but Carlton noted that the majority cost less than seven *soldi piccioli*. The most variable maps in price were the navigational charts, which ranged from as little as three *soldi* to seven *lire* (140s).[85] Although it is possible that the prices noted by Delano-Smith were inaccurate valuations by notaries unaware of market prices, Carlton argued that the prices in her inventory were most likely the retail price for each item.[86]

A few additional references to the price of portolan charts in the sixteenth and seventeenth centuries may be added to those already discussed. Concerning undecorated maps, a 1586 letter from Dutch cartographer Lucas Janszoon Waghenaer to Claes Adryaensz, a merchant at Delft, Waghenaer noted that the price of two portolan charts printed on parchment was twenty *stuivers* each.[87] For his 1576 voyage, Martin Frobisher bought several maps: he paid five pounds sterling for "a very great carte of navigation", £1 6s. 8d. for "a great mappe universall of Mercator in prente" and £2 sterling for "6 cardes of navigation written in blanke parchment whereof 4 ruled playne & 2 rounde".[88] Presumably the latter were small undecorated charts or possibly ones which were only ruled with rhumb lines but without hydrography or toponymy, to be used for the drawing of new discoveries on the voyage.

Along similar lines to the earlier centuries, luxurious charts would fetch a much higher price: Astengo noted that a c.1545 Agnese atlas was bought by Duke August of Wolfenbüttel for 200 *ducats* in 1643, according to an attached note, though Wagner made

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[83] Delano-Smith, Catherine: 'Map Ownership in Sixteenth-Century Cambridge: The Evidence of Probate Inventories', *Imago Mundi*, 47 (1995), 67-93. pp. 82-85.

[84] Tyacke: (2007), p. 17.

[85] Carlton: (2011), pp. 119-121.

[86] Ibid. p. 122.

[87] The Dutch 'stuiver' was the equivalent of the shilling. Koeman, C.: 'Lucas Janszoon Waghenaer: A Sixteenth Century Marine Cartographer', *The Geographical Journal*, 131: 2 (1965), 202-212. p. 205.

[88] Waters, David W.: *The Art of Navigation in England in Elizabethan and Early Stuart Times*, 2nd edn., 3 vols. (Greenwich: Trustees of the National Maritime Museum, 1978), vol. 3. p. 530.

no mention of this in his catalogue of Agnese manuscripts.[89] Additionally, and oft cited, is the sumptuous 1439 Gabriel de Valseca chart, on the back of which was written "Questa ampla pelle di geografia fue pagata da Amarigo Vespucio cxxx ducati di oro di marco."[90] There is no date on this inscription, though the purchase was probably after 1490, and certainly before 1512 when Vespucci died. Although it is possible the price written in the inscription was exaggerated in order to artificially inflate the map's value later on, Pujades doubted the authenticity of the inscription altogether and argued that if it was genuine, Amerigo must have been entirely ignorant of the market price for the chart which was geographically obsolete and aesthetically unfashionable.[91] While 130 *ducats* does seem to be a rather extreme cost, given some of the prices fetched for de luxe maps, it is certainly not impossible.

Profit

Through an understanding of the prices fetched for different types of portolan charts, the profit margins made by chart-makers can be deduced. It is a moderately safe assumption that the charts averaging a price of 30-40 *sueldos* were undecorated, charts costing 80-120 *sueldos* had minimal decoration, i.e. a couple of city illustrations, and/or some flags, and/or a couple of compass roses, with the price increasing for each additional illustration, or text, or the use of gold or silver leaf. The added value of gold is indicated by a document dating to between 1521 and 1523: "una carta de navegar, tota daurada e molt pintada" was worth twenty-four pounds (480 *sueldos*).[92] Using the timings gleaned from the experimental reconstruction of the first chapter, an undecorated chart might have taken only thirty man-hours hours to make, but one with a few city illustrations, flags, and compass roses – like the reconstructed chart – might only have taken an extra five to ten hours of work, but would have sold for at least double the price. Though a decorated chart would have used more materials, the extra cost would probably not have been equal to the extra profit made, and thus chart-makers more than likely preferred making decorative maps whenever possible, especially on commission because it was a guaranteed sale.

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[89] Astengo: (2007), p. 182. The atlas itself is in Wolfenbüttel: Herzog August Bibliothek, Cod. Guelf. 4. 1 Aug. 4°. The atlas is number XLII in: Wagner: (1931), p. 80.

[90] "For this large geographical parchment, Amerigo Vespucci paid 130 gold mark ducats". Pujades i Bataller: (2009), p. 358.

[91] Pujades i Bataller: (2007), p. 505 (note 171).

[92] Ibid. p. 501.

Wages

Any discussion of price is meaningless without an understanding of the average wages of the time, and the purchasing power of individuals. Account books indicate that the officers of a particular Barcelonian ship owned by the Just brothers were paid the following annual wages in 1332: forty pounds to the boatswain, twenty-seven to the pilot, and between fifteen and nineteen pounds to other senior officers.[93] Two other documents noted by Pujades confirmed the same wage was paid to the boatswains of ships in 1342. After the Black Death, salaries appear to have nearly doubled: in 1360/61 a particular Majorcan boatswain earned ten *florins* per month (eighty Majorcan pounds per year), and in the 1380s, a barber-surgeon named Joan Martí earned a monthly salary of twelve *florins* (ninety-six pounds per year), and was not even the most senior officer.[94] Pujades noted however that in the fifteenth century, salaries amongst Catalan sailors began decreasing substantially: a 1455 document indicated that a boatswain's salary was 110 *sueldos* per month (sixty-six pounds annually), whereas some less senior officers were paid as little as thirty-three *sueldos* per month (19.8 pounds annually).[95] Pujades discussed that the situation in Genoa and Venice was similar: an increase in salaries after 1350, followed by a steady decrease into the mid-fifteenth century.

From the sixteenth century onwards, while there has been some publication concerning the wages of skilled and unskilled craftsmen in early modern Italy and the rest of Europe, very little has been published concerning the wages of seafarers.[96] Goldthwaite calculated that, in Florence, the average daily wage for unskilled and skilled labourers in 1450 was ten *soldi di piccioli* and seventeen *soldi de piccioli* respectively, in 1500 was about nine and fifteen respectively, in 1550 was about twelve and twenty, and by 1600 had risen to twenty-two for unskilled and almost fifty *soldi di piccioli* for skilled workers.[97] Assuming these labourers worked twenty-five days per month, converted into *sueldos*, these wages for

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[93] Ibid. p. 499.

[94] Ibid.

[95] Ibid.

[96] Studies which have presented information about the wages of skilled and unskilled labourers include: Pullan, Brian: 'Wage-Earners and the Venetian Economy, 1550-1630', *The Economic History Review, New Series*, 16: 3 (1964), 407-426; Goldthwaite, Richard A.: *The Building of Renaissance Florence: An Economic and Social History* (Baltimore: Johns Hopkins University Press, 1980); Allen, Robert C.: 'The Great Divergence in European Wages and Prices from the Middle Ages to the First World War', *Explorations in Economic History*, 38 (2001), 411-447.

[97] Goldthwaite: (1980), pp. 436-438.

unskilled and skilled labourers would have been fifty-five and ninety-three *sueldos* respectively in 1450.[98] Calculations beyond 1480 were not possible given the data set provided by Spufford et al. (although there is a suggestion of significant deflation in the value of the *soldi piccioli*), but the comparison shows that naval officers were not paid significantly more than skilled craftsmen, and the wages of craftsmen therefore could be considered indicative of the wages of naval officers.

One study by Brujin et al. concerning wages in the Netherlands noted that the wages of an ordinary seaman on a merchant vessel would have been around fourteen *guilders* per month towards the end of the seventeenth century, or more if the country was at war, though the East India company paid less: only seven to eleven *guilders* per month.[99] Naval captains earned only thirty *guilders* per month, but also received a bonus of thirty-five *pfennigs* per man per day, and Brujin noted that Admiral De Ruyter earned roughly 10,000 *guilders* during a summer campaign captaining the flagship.[100] Dutch merchant captains and some senior officers additionally enjoyed bonuses from quick delivery known as 'primage', and had the right of 'voering', or carrying some personal cargo for sale and independent profit.[101] Pujades noted that similar bonuses often existed for medieval Italian and Catalan captains.[102]

As a result of the evidence of wages, one can be somewhat confident that the wages of seafaring officers were stable, and for officers were moderately comfortable. Certainly however, more scholarship in this area is necessary to achieve a more thorough understanding. Additionally, the documentary evidence concerning the price of portolan charts indicates that there existed two classes of nautical maps, as several scholars have suggested.[103] The first were inexpensive and undecorated, and according to the documentary evidence, never seemed to exceed about a third of the monthly salary of the

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98 According to the conversion tables given by Spufford et al., in 1450, eighteen *sueldos* were equivalent to one *florin*, which was itself equivalent to eighty-two *soldi piccioli*. By 1500 however, the value of the *soldi piccioli* had plummeted to 140 to one *florin*, but there is not enough information to know if its theoretical conversion to *sueldos* was similarly affected by inflation. Spufford et al.: (1977), pp. 37, 175.

99 The *guilder* was the Dutch equivalent to the gold *florin*, and equal to twenty *stuivers*. Brujin, Jaap R. et al.: 'Seamen's Employment in the Netherlands (c 1600 - c 1800)', *The Mariner's Mirror*, 70: 1 (1984), 7-22. pp. 13, 16.

100 Ibid. p. 18.

101 Ibid. p. 14.

102 Pujades i Bataller: (2007), p. 505 (note 151).

103 See: Campbell: (1987), p. 440; Pujades i Bataller: (2007), p. 456; Astengo: (2007), p. 177.

naval officers that apparently purchased them, as discussed in the section on ownership. The second were decorated maps that ranged in price from only a little more than undecorated ones, to significant amounts of money that exceeded the annual salary of these naval officers, but was well within the purchasing power of wealthy merchants, knights, nobles, and royalty. This duality is embodied in a 1437 inventory of the assets of deceased Majorcan merchant Nicolau de Quint which listed two charts: the first, found in the kitchen, was described as 'pocha' (small), 'squinçada' (torn), and was kept with two dividers, whereas the second, located in the study was described as 'molt bela' (very beautiful).[104]

It remains to be questioned however, into which of these two categories portolan atlases fall, or should they be considered separately? Unfortunately, few of the contemporary documents discussed nautical atlases specifically, which from their survival were certainly not rare productions. However, there existed no term to necessarily differentiate an atlas from a single chart. The word 'atlas' was only first used to describe a collection of maps by Mercator in his 1585 publication: *Atlas, sive cosmographicae meditationes de fabrica mundi*. In the documents transcribed by Pujades, there are several phrases which may refer to atlases, most of which were variations of *tabulas navigandi* or *libre de navegar*. Three however certainly refer to atlases. First, the 1323 inventory of the assets of James II of Aragon referred to "una carta de navegar que és in IV taules plegadices."[105] Second, in a 1330 letter from Marino Sanudo to the the Bishop of Ostia concerning his *Liber secretorum*, he referred to the atlas as "cui librum etiam praesentavi cum pluribus mappis mundi."[106] Finally, a 1484 inventory of the assets of a doctor of law in Palermo included "librum unum in quo est tota et integra carta navigandi."[107]

While these particular atlases were most likely not used for navigation, there are not enough references specific enough to differentiate atlases from charts to make an assessment based on secondary evidence. Many atlases were decorated, and it seems reasonable to group the decorated atlases with decorated charts as maps that were not used for navigation. Undecorated atlases might meanwhile have played a more archival or scholarly role; although Campbell suggested that atlases used for navigation had several

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[104] Pujades i Bataller: (2007), pp. 437, 456.

[105] "A nautical chart which is in four folding boards." Ibid. p. 428.

[106] "Whose book is also presented with a number of maps of the world." Ibid. p. 439.

[107] "One book in which there is an entire and complete nautical map." Ibid. p. 438.

advantages over charts, none of the documents discussed above (which concern the use of maps at sea) refer to the use of atlases.[108]

The Pace of Production, Reiterated

One of the primary aims of the first chapter was to explore – through an experimental archaeological reconstruction – the production processes of portolan charts, and to discover how much time each of the constituent stages in construction would have taken. The results from this experiment were that the making of a single chart of the Mediterranean Sea without decoration would have taken at least two weeks, and probably a full three weeks if the chart included the Black Sea and Atlantic coastlines. It was extrapolated that atlases covering the same regions would have taken a little longer because of the overlap of content. The extent of ornamentation then added to the time: a minimally-decorated chart, perhaps like one that cost six Majorcan pounds (90 *sueldos*) in 1436, might have taken one extra week to complete, but as the evaluation of price indicated, would cost at least double. A highly ornamented map like the 'carta de luxe' sold in Perpignan in 1404 might have taken the chart-maker two or three months to complete, which explains its price of fourteen pounds (280 *sueldos*).[109]

The discussion at the end of the first chapter does not need repeating here, but its conclusions do warrant reiteration. First, the discussion indicated that Pujades' conclusion that Valseca must have had an atelier was possibly incorrect.[110] The contract to produce twenty-four charts in six months could have been completed by Valseca himself if the charts he made were undecorated and only of the Mediterranean. Second, the discussion posited that there is little evidence to suggest that large cartographic workshops were the normal engines of production. The evidence of fifteenth and early sixteenth-century Genoa suggests a scarcity of chart-makers: Agostino Noli was the only cartographer in the city in 1438, Bartolomeo Pareto the only one in 1453, and in 1518, lacking cartographers, the doge offered a substantial stipend to Vesconte Maggiolo.[111] According to the 1408 Datini letters, there was only one chart-maker on Majorca: 'Il Bizaro'.[112]

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[108] Campbell: (1987), p. 440.

[109] Pujades i Bataller: (2007), pp. 279-280.

[110] A transcription and discussion of the contract are provided in: Ibid. pp. 497-498.

[111] Astengo: (2007), pp. 209-210; Campbell: (1987), pp. 430, 434.

[112] Pujades i Bataller: (2007), p. 436; Pujades i Bataller: (2009), p. 312.

Furthermore, chart-making seemed to have been a part-time activity in Venice, or done in retirement: Andrea Bianco's primary profession was a boatswain, Andrea Benincasa was 'capitano del porto' of Ancona, and Antonio Pelechan was 'armiraio' of Rythymnon.[113] Gratiosus Benincasa, one of the most prolific chart-makers, began later in life after retiring as a 'padrone' (ship owner or captain).[114] Zuane and Cristoforo Soligo, of whom a chart each was copied in the Cornaro atlas, appear to have been owners of Venetian merchant vessels in the middle of the fifteenth century.[115] Farther afield, Tyacke noted that manuscript chart-making in sixteenth-century London was "a small paid activity… [and] not enough to provide full time employment".[116]

The itinerancy of many chart-makers precluded the existence of established ateliers as well: Gratiosus Benincasa operated in Genoa, Venice, Rome, and Ancona, often staying no more than a few years in each place.[117] Between 1550 and 1572, Jaume Olives made charts in Marseilles, Messina, Naples, and Barcelona, and his grandson Joan operated similarly.[118] Overall, there is more evidence to suggest that most chart-makers operated individually with a single apprentice, than established large workshops to mass-produce charts.

The large scale production of "numerous and necessary" navigational maps would have required a number of significantly-sized ateliers spending all of their resources on the quick production of inexpensive undecorated maps. This scenario suggests that at least one and at times several major ateliers were located in Majorca, Venice, and Genoa in the fourteenth century, with the addition of Ancona in the mid-fifteenth century, and in the sixteenth century expanding to Naples, Messina, Marseilles, Livorno, as well as northern Europe including England and the Netherlands, not to mention the state cartographic outputs of the Spanish Casa de Contratación and Portuguese Casa da Mina. Would there really have existed a market for thousands of new nautical charts to have been made every year?

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113 Campbell: (1987), pp. 432, 434.

114 Ibid. pp. 433-434.

115 Gautier Dalché: (1996), p. 105.

116 Tyacke: (2007), p. 5.

117 Campbell: (1987), p. 432.

118 Astengo: (2007), pp. 226-228 & appendix 7.2.

The answer is certainly debatable, but if it was true, one would expect there to exist more evidence of large ateliers, a greater number of known cartographers, and more utilitarian map survivors. A more likely scenario, given the lack of evidence of ateliers and the scarcity of portolan map-makers as demonstrated in the evidence, is that most master cartographers employed a single apprentice and perhaps an assistant. Fourteenth-century statutes of the Venetian artists' guild indicate that workshops were limited to one master, one apprentice, and two assistants.[119] In many cases, as evidenced by the signed charts themselves, this was often a family member, examples of which include: Petrus and Perinus Vesconte, Abraham and Jefuda Cresques, Gratiosus and Andrea Benincasa, Conte Ottomanno and Angelo Freducci, Pietro and Jacopo Russo, Augustin and Jean François Roussin, Estinenne and Jean André Bremond, Giovanni Battista and Pietro Cavallini, and the Maggiolo, Caloiro, Olives, and Prunes family dynasties. Instead of large ateliers, these small 'master and apprentice' workshops would have produced charts and atlases according to market demand. This would explain why some held other jobs like Andrea Benincasa or Antonio Pelechan, or others, like Agostino Noli, struggled to pay their taxes because business was so poor. If demand for utilitarian nautical maps was high, the evidence would indicate many more chart-makers supplying that demand, but this is not the case.

Of course, some undecorated maps must have been made because there is considerable evidence of their existence. However, the prices discussed above indicate that profit could be best achieved not by mass-producing hundreds of undecorated maps without knowing that they would definitely sell, but by producing decorated maps, either on commission or perhaps even as stock in places where the market existed for them. Given the number of contracts Abraham Cresques received for incredibly expensive de luxe charts, it is unlikely he would have bothered making a great number of inexpensive undecorated ones. A few might have been made by him and his son/apprentice Jefuda (Jacme Ribes post-conversion) when there were no contracts to fulfill, but their primary income would not have been from undecorated maps.

Conclusion

The documents and literature contemporaneous to the genre of portolan maps are invaluable sources that, despite limitations, provide a context through which a better understanding of these maps can be achieved. The discussion of literature, although

[119] Campbell: (1987), p. 430.

perhaps the most limited of the documentary sources as a result of authors' selectivity and hyperbole, showed that as early as 1270, maps were mentioned on board ships, and in several cases, seemed to be consulted in emergency situations. The appearance of the portolan map in literature also indicates that they were known to scholars, and not simply esoteric documents only seen on ships. However, the literary references to portolan maps were mostly unspecific about their actual function.

Although one might expect that nautical technical manuals would discuss the use of charts in detail, only one pre-sixteenth-century manual – Cotrugli's *De Navigatione* – noted the existence of charts. Although Falchetta and Pujades each posited different reasons for this, it is nevertheless curious that a supposed vital instrument of navigation would not at least briefly noted in several manuals. However, some later sixteenth-century manuals did discuss the use of charts at sea to 'take point' (i.e. calculate one's position based on heading, speed, elapsed time, and previous position), but again were not specific about how often this was done, or how necessary it was.[120]

Concerning ownership, the results for the fourteenth and fifteenth-centuries were that mariners owned approximately two-fifths of the maps, while the rest were owned by merchants, nobles, clergymen and other professional landsmen. While all undoubtedly shared an interest in the sea, not all maps, and perhaps not even half, were owned by people who perhaps required them for navigation. Moreover, the suggestion that maps owned by seafarers were used for navigation is entirely circumstantial. Although the documentary sources for ownership in the sixteenth and seventeenth-centuries were too incomplete to graph percentages of types of owners, the overall picture is that numerous maps were owned by those who did not need them for practical seafaring.

The evaluation of the market for portolan maps indicated that there were two types of portolan map: undecorated ones, of which the price was a relatively stable one or two pounds and no more than a third of the monthly salary of a junior naval officer; and decorated maps which began at double the price for only a minimal amount of decoration, to twenty pounds or more for extravagantly-ornamented works of cartographic art. Through synthesis with the results of the reconstruction chapter, it was surmised that the overall profit margins would have been higher on decorated maps than undecorated ones.

[120] The theoretical methods of using a chart at sea are discussed in detail in Chapter IV.

Synthesis of the documentation with the results of the first chapter indicated that Pujades' hypothesis that thousands of undecorated nautical maps were produced is fallacious. The evidence of a lack of major ateliers, only a few chart-makers in operation at any given time, and the speed at which a single chart could be made, all indicate that not that many maps were produced because there was not a market for them. Instead of chart-makers producing hundreds of navigational maps to sell, it is more likely that no more than necessary were made, and their efforts were focused instead on making decorative maps with a higher profit margin.

The aim of this chapter was to better understand the functions of portolan maps through the evaluation of contemporaneous sources. The evidence does not seem to indicate that portolan maps were solely or primarily navigational, as many scholars have suggested, yet there is nevertheless evidence of the use of charts at sea, enough to suggest that navigation was at least one aspect of their purpose. The next chapter will analyse the practicalities of the use of portolan maps, discussing what can be determined about their function from their two most utilitarian aspects: their toponymy and hydrography.

IV: Part I, The Utilitarian Map

The previous chapter discussed the documents and literature that were contemporaneous to the genre of portolan charts, with the aim of gaining a better understanding of their function. Although some of the contemporary documents indicated the use of charts on board ships, many of them were unspecific about how this was accomplished. Other documents suggested that the market for undecorated maps was smaller than has been theorised, and posited that chart-makers preferred producing decorated maps. The first part of this chapter will focus directly on the practicalities of the use of maps, and will examine the two primary functional aspects of the portolan map genre: toponymy and hydrography. As the first chapter indicated, it is unlikely that cartographers copied from different exemplars for different maps, thus both utilitarian and luxury charts would have shared the same toponymy and hydrography.

Although the nature of toponymy will be discussed, a comprehensive original study of the accuracy and change of the toponyms of charts is beyond the scope of this thesis.[1] The accuracy of the hydrography of the maps will be analysed however, as well as how it evolved, and how new discoveries were incorporated. Furthermore, an assessment will be made of the problems of the size and inconsistencies of scale, and magnetic deviation. However, before the technical practicalities may be fully appreciated, this thesis must elucidate how naval technology evolved, and navigation was practised in the medieval and early modern periods, to formulate a grounding from which the utility of portolan maps may be assessed.

Late Medieval and Early Modern Seafaring

The eleventh century witnessed a major revival of seafaring in the Mediterranean. Genoa and Pisa emerged as major maritime powers after expelling the Muslims from Corsica and Sardinia. Additionally, the success of the Normans in Sicily, the Venetian

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[1] Ongoing toponymic research by Campbell has proven useful, and Pujades has indicated that a substantial toponymic study is forthcoming. See: Campbell, Tony: 'Table of 'Significant Names'', (2013) <http://www.maphistory.info/SigNamesFullTable.doc> [accessed 2 October 2013], and Pujades i Bataller, Ramón J.: 'The Pisana Chart: Really a primitive portolan chart made in the 13th Century?', *Comité Français de Cartographie*, 216 (2013), 17-32. p. 21.

alliance with Byzantium, and the First Crusade all brought about a drive to expand naval power. This continued in the twelfth and thirteenth centuries through further crusades, conflicts with both Muslims and each other, and the development of the Crown of Aragon as a major maritime power, culminating in the expulsion of the Arabs from Majorca and the Balearics between 1229 and 1231.[2]

Along with this increasing maritime activity, there was a corresponding evolution in ship design. Most powers employed oared war galleys for military purposes through the end of the sixteenth century. Much longer than they were wide, these '*galee*' initially employed a single bank of oars, a single lateen or square sail, and an above-water ramming beak designed to immobilise (but not sink) enemy ships.[3] The thirteenth century witnessed the addition of a second mast on many galleys, and by the fourteenth century they began employing three oarsmen per bench instead of two.[4] Amongst merchant vessels, the earliest post-Roman ships were small and shallow-keeled with only a single square sail, but by the eleventh century, the merchantmen had become larger, with two or sometimes even three masts with a single triangular lateen sail each, known as '*naves*'. The advantages of the lateen sail – which was probably adopted from Arab vessels – were that a ship could theoretically maintain its course with a heading as much as 60º off the wind (whereas the square-rigged vessels of the time could only manage about 80º), giving them a significant advantage in uncooperative weather conditions. John Prior argued however, that in real terms, taking leeway into account, 90º was the best angle that could have been achieved, and only at great difficulty.[5] Additionally, lateen-rigged ships required more sailors and were more complicated to adjust in shifting winds.[6] From medieval accounts of the lengths of voyages, it seemed these fat and shallow ships could, at best, only manage a downwind speed of 2.25 knots, and upwind speed of about 1.15 knots.[7] As a result, ships would have

[2] Abulafia, David: *The Western Mediterranean Kingdoms, 1250-1500: The Struggle for Dominion*, ed. by David Bates (Harlow, Essex: Longman, 1997). pp. 37-40.

[3] Pryor, John H.: *Geography, Technology, and War: Studies in the maritime history of the Mediterranean, 649 - 1571*, ed. by Paul Slack, Past and Present Publications (Cambridge: CUP, 1988). pp. 63-64.

[4] Ibid. p. 64.

[5] Ibid. pp. 33-35.

[6] Lewis, Archibald R. et al.: *European Naval and Maritime History, 300-1500* (Bloomington: Indiana University Press, 1985). pp. 66-68 ; Scandurra, Enrico: 'The Maritime Republics: Medieval and Renaissance ships in Italy', in *A History of Seafaring, Based on Underwater Archaeology*, ed. by George F. Bass (London: Omega, 1974). pp. 213-214.

[7] Pryor: (1988), p. 36.

‘hopped’ from port to port along well-known coastal trunk routes, traveling only during certain times of the year when the prevailing winds were favourable.

The desire for larger merchant ships to increase profitability caused fourteenth-century shipwrights to adopt the northern European cog: a square-sailed ship with a deeper keel, straight stern and stem-posts, and stern-post rudder. Quickly however, Mediterranean shipbuilders added to the cog a second mizzen-mast with a lateen sail, to combine the advantages of both. This new ship would eventually develop into the three, and later four and five-masted carrack. Pryor noted that the carrack was considerably easier to handle than a fully lateen-rigged ship and could sail at 80º to the wind, enabling it to deal with dangerous lee shores.[8] Additionally, its larger size – an average of 400 tonnes in 1400 and 1,000 tonnes by 1500 – allowed for longer periods of time between resupplying, which enabled voyages down the coast of Africa and into the Atlantic in the fifteenth century.[9]

New technologies appeared during these centuries as well. The hourglass, known as an ‘*orologium*’, began to appear in inventories in the thirteenth century, but possibly originated earlier.[10] The earliest mention of an astrolabe is dated to 1024, when a school-master named Ragimbold from Cologne wrote to a friend in Liège that he had acquired an astrolabe which served for time-keeping, astronomy, astrology, and the making of calendars.[11] Written sailing directions, known as ‘*portolani*’ (Italian) or ‘*periploi*’ (Greek), and from which portolan charts have (perhaps incorrectly) derived their name, seem to have been produced in greater numbers in the later Middle Ages. The earliest known *periplus* was originally compiled by Scylax of Caryanda around 500 BC, but must have been disseminated throughout the Roman and early medieval period, because a copy of it survives in Paris dated to the twelfth century, significantly annotated and brought up to date.[12] The earliest known original *periplus* from the Middle Ages was in the eleventh-

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[8] Ibid. p. 42.

[9] Scandurra: (1974), p. 214.

[10] Francesco da Barberino referred to one in his *Documenti d’Amore* from 1306-1313. See: Taylor, E. G. R.: *The Haven-Finding Art: A History of Navigation from Odysseus to Captain Cook* (London: Hollis & Carter, 1956). pp. 116, 140. Hourglasses also appear in a number of Pujades’ presented documents: Pujades i Bataller, Ramón J. : *Les cartes portolanes: La representació medieval d’una mar solcada*, trans. by Richard Rees (Barcelona: Institut Cartogràfic de Catalunya, Institut d'Estudis Catalans, Institut Europeu de la Mediterrània, 2007). pp. 428-439.

[11] Taylor: (1956), p. 90.

[12] Hewson, J. B. : *A History of the Practice of Navigation*, 2nd edn. (1951; repr. Glasgow: Brown, Son & Ferguson Ltd., 1983). p. 5.

century *Gesta Hammaburgensis Ecclesiae Pontificum* by Adam of Bremen, though Lanman noted it was rather inaccurate.[13] These compilations of written directions essentially listed the names of places around the coast, with the directions and distances between each, and most likely were used by navigators for calculating voyages. The similarity of information between these documents and portolan maps has been established: Lanman was able to reconstruct a comparable, if primitive-looking, portolan chart using nothing but the sailing directions from two *periploi*: the *Lo Compasso de Navigare*, dated 1296 but which was likely a later copy, and the Parma-Magliabecchi *portolano*, from the fifteenth century.[14]

The compass also appeared in the late eleventh or twelfth century, though its provenance is still a matter of debate: some have argued that it was brought to Europe via Persia and Arabia from China, while others have discussed its possible invention in Amalfi.[15] Hewson argued that a primitive compass may have been independently invented in many disparate places throughout the world, and noted that the earliest documentary evidence for a compass – the use of the Icelandic word '*leidarstein*' (which literally translates as 'guiding stone') – dated to the end of the eleventh century in a text by Norwegian chronicler Ada Frode, discussing a ninth-century voyage from Norway to Iceland.[16] More often cited by historians of cartography as the earliest documentary evidence of the compass, was the description given by Alexander Neckham in his *De Utensilibus* from c. 1190, in which he wrote: "they also have a needle placed upon to a dart, and it is turned and whirled round until the point of the needle looks north-east. And so the sailors know which way to steer when the Cynosure is hidden by clouds."[17] In his *De Naturis Rerum*, written around the same time, Neckham described how the iron needle was magnetised by placing it upon a magnetic stone.[18] Hewson additionally noted the late-twelfth-century French poem *La Bible de Guyot de Provins* quite accurately described a compass.[19]

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[13] Lanman, Jonathan T.: *On the Origin of Portolan Charts*, The Hermon Dunlap Center for the History of Cartography, Occasional Publication, No. 2 (Chicago: The Newberry Library, 1987). p. 3.

[14] Ibid.

[15] Taylor: (1956), p. 92; Scandurra: (1974), p. 214; Hewson: (1983), pp. 45-47; Campbell, Tony: 'Portolan Charts from the Late Thirteenth Century to 1500', in *The History of Cartography*, ed. by J. B. Harley and David Woodward, 3 vols. (Chicago: UCP, 1987), vol. 1, pp. 371-463. p. 384.

[16] Hewson: (1983), pp. 46-47.

[17] Translation from: Taylor: (1956), p. 95.

[18] Hewson: (1983), p. 49; Taylor: (1956), p. 95.

[19] Hewson: (1983), p. 48.

There has been disagreement about the impact of the invention of the compass. Lane hypothesized that the compass provided the benefit of making navigation possible when it was overcast and at night. This led to the increase in the length of the sailing season from March through October to February through November or even December, which has been confirmed by several cartulary records, especially in Venice.[20] Pryor, in his discussion of the compass, argued that it had never really been necessary in the Mediterranean, but admitted that it reduced reliance on visual landmarks, and agreed with Lane that seafaring during winter months had been eased.[21] Pujades provided five documentary examples of the use of a compass onboard ships, including one that recorded the importation of thirty-seven compasses in Barcelona from Venetian merchant Jacobo Dandollo at the cost of seven pounds and ten *sueldos*, which Pujades argued indicated a strong demand for compasses; so much so that they were being imported in high numbers, and that there existed a market to produce them for export.[22]

With the advent of these newfound nautical instruments, many scholars posited that the process of navigation in the Mediterranean changed from the adherence to well-known coastal trunk routes during months of temperate weather, to voyages out of sight of land in increasingly inclement conditions with larger ships. However, Braudel noted several primary sources which indicated that even in the sixteenth century, many voyages still clung to the shores, voyaging from port to port, and he discussed the numerous advantages of coastal seafaring over open-water sailing.[23] When in sight of land, following a well-established and known course, an experienced ship's pilot did not require any of the aforementioned instruments to aid him; he knew his ship, the winds, the coast, and the waters through which he sailed. However, the use of these instruments, while perhaps not necessary, would have increased efficiency: the ability to sail for more months of the year, in more direct courses away from the coast, and would have enabled merchants to trade more often.

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[20] Lane, Frederic C.: 'The Economic Meaning of the Invention of the Compass', *American Historical Review*, 68: 3 (1963), 605-617. pp. 607-608.

[21] Pryor: (1988), p. 53.

[22] Pujades i Bataller: (2007), pp. 457-458.

[23] Braudel, Fernand: *The Mediterranean and the Mediterranean world in the age of Philip II*, trans. by Siân Reynolds, 2nd rev. edn., 2 vols. (Berkeley: University of California Press, 1995), vol. 1. pp. 103-108.

The Technical Process of Navigation

The methods by which these instruments were used to navigate in the Mediterranean have been discussed by several scholars.[24] In addition, there exist several primary sources that described the process, which was generally termed 'pricking the chart' or 'taking point'. The earliest reference comes from the Majorcan polymath Ramón Llull in his *Arbor Scientiae*, written in Rome c.1295-96. Llull described, in basic terms, the trigonometry involved between a ship making its actual course (as determined by the winds and currents), and the direction and distance needed to then return to its intended course and arrive at the desired destination.[25] Tables of these trigonometric calculations were known as the '*Toleta de Marteloio*', and were sometimes included with portolan atlases: the earliest surviving table appears in Andrea Bianco's atlas of 1436.[26] His description, however, was largely academic as he was not prescribing a method for sailors to actually follow. The earliest description of the process of navigation was included in Benedetto Cotrugli's unpublished treatise *De Navigatione* from 1464-65, which will be discussed in greater detail below. Several sixteenth-century nautical manuals also described a similar process, with the additional inclusion of latitude. These manuals include, but were not limited to: Alonso de Chaves' c.1530 work *Quatri partitu en cosmografia practica*;[27] John Rotz' *Boke of Idrography* from 1542;[28] Martín Cortés' *Arte de Navigar*, published in 1551;[29] and Lucas Janszoon Waghenaer's 1583 manual, *The Mariner's Mirrour*.[30]

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[24] Taylor: (1956), pp. 117-121; Hewson: (1983), pp. 155-187; Kelley Jr., James E.: *Analog and Digital Navigation in the Late Middle Ages* (Melrose Park, PA: Sometime Publishers, 2000). pp. 1-152; Ash, Eric H.: 'Navigation Techniques and Practice in the Renaissance', in *The History of Cartography*, ed. by David Woodward, 3 vols. (Chicago: UCP, 2007), vol. 3, pp. 509-527; Pujades i Bataller: (2007), pp. 462-463; Gaspar, Joaquim Filipe Figueiredo Alves: 'From the Portolan Chart of the Mediterranean to the Latitude Chart of the Atlantic: Cartometric Analysis and Modeling' (Doctoral Thesis, New University of Lisbon, 2010). pp. 11-21.

[25] Taylor: (1956), pp. 117-121.

[26] Campbell: (1987), p. 442.

[27] Kelley Jr.: (2000), p. 33.

[28] Ibid. pp. 30-32.

[29] Hewson: (1983), pp. 183-187 ; Cortés, Martín de Albacar: *Breve Compendio de la Esfera y del Arte de Navigar* (Seville, 1551). <http://documentomovil.usal.es/visor.php?f=nautica_bg_CortesAlbacar&v=dicter&p=1> [accessed 22 January 2013], pp. 150-153 (ff. 74r-75v).

[30] Kelley Jr.: (2000), p. 15.

Navigation in the Mediterranean

Although primitive astrolabes had existed for a couple of centuries, navigation before the mid-fifteenth century did not take latitude into account. Due to the orientation and shape of the Mediterranean, latitude was not a major concern for early navigators. Benedetto Cotrugli was the first to describe the process of determining the course and position of a ship in his treatise *De Navigatione*.[31] To begin, the navigator would need to know his current position, the position of where he wanted to be, and determine which rhumb line (compass direction) ran parallel to that course. This is labelled as the 'intended course' (A-B) in figure 4.1. Then, the navigator would need to choose an actual course to sail according to the winds, currents, and the direction desired. In figure 4.1, this is designated as the 'actual course' (A-C). Occasionally, the wind would have been favourable, and the intended course could be the actual course. Often however, the pilot would be required to choose a direction that would allow the ship to operate efficiently in the wind, not navigate near any dangerous areas (lee shores, rock outcroppings, sand-bars etc.), yet still achieve progress towards his actual course.

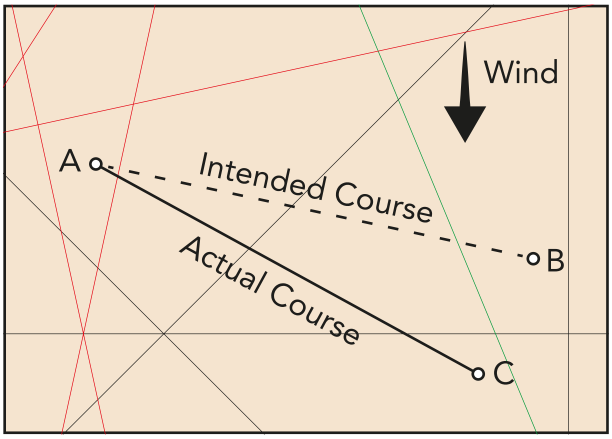

Figure 4.1: 'Intended Course' versus 'Actual Course'. In this scenario, the navigator, wanting to travel from point A to point B, must sail less perpendicular to the prevailing wind, and will actually travel towards point C.

Cotrugli noted that the navigator must know the speed of his ship, taking into consideration the capability of the vessel, the strength of the winds, and the currents. The art of making this estimation was something only a skilled pilot (who knew his ship well) could accomplish. Additionally, to avoid dangerous areas, Cotrugli recommended that the navigator should determine the present location of the ship every hour by knowing how many miles were traveled, and in which direction. This was, according to Cotrugli, accomplished using a chart with two pairs of dividers (*sestes*) in a process he described as '*apuntar*' (finding the point). With one pair of dividers, the estimated distance sailed was measured on the scale, and then with one point on the origin (point A), a circle or arc was

[31] The relevant sections of *De Navigatione* are: New Haven: BRBML, MS. 557. ff. 29r, 32r-34r, 42v-43r, 61v-62v. For a transcription of these sections of the manuscript see: Pujades i Bataller: (2007), p. 446, and Kelley Jr.: (2000), pp. 25-27.

imprinted around the area where the ship was thought to be. With the second pair of dividers, one tip was placed on the origin, and the other tip at the nearest tangent point on the rhumb that was being followed. This was then traced down parallel to that followed rhumb line, and where the two lines crossed was the estimated position of the ship. The next time the navigator 'took point', he would have used the previous location as the origin, and measured to find the new location of the ship.[32] Thus, a series of points would have been measured and made, adapting the course to favourable winds to reach one's destination.

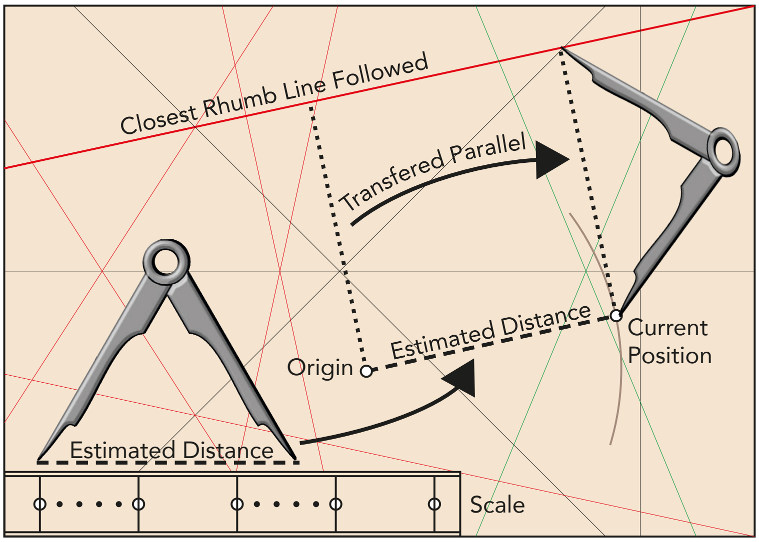

Figure 4.2: The process of 'taking point'. The estimated distance would be measured with one pair of dividers and transferred from the origin to an arc of estimated distance. The second pair of dividers would transfer the parallel of the direction followed.

As discussed in Chapter III, Cotrugli's text was never published, and it is curiously the only one of several pre-sixteenth-century manuals that indicated this process was performed using a chart. In theory, the estimated position of the ship would have had to be determined every time the course required alteration. In practice however, sailing ships were (and are) rarely able to maintain a direct course for a long period of time: winds constantly shift, and together with currents, cause ships to point in one direction but travel in another (known as lee drift), and at times the ship might be forced to tack in short zig-zag vectors to make a general course against the wind. In these circumstances, it was the experience of the pilot and officers that would be needed to estimate the overall direction and distance travelled. At times this was difficult to synthesize, as attested in several accounts discussed in Chapter III, including the account of Guillaume

[32] Cotrugli's process was described well in Pujades i Bataller: (2007), p. 462, and Kelley Jr.: (2000), pp. 25-27.

de Nangis in his c.1270 *Gesta Sancti Ludovici*,[33] the account of Roberto da Sanseverino in his 1458 voyage to Crete,[34] and friar Pietro Casola's 1494 account, which noted that even the charts did not help them resolve their position.[35] Certainly wherever possible, landmarks would have been used to determine position, and it was the experience of the crew that was paramount to navigation.

Navigation with Latitude in the Atlantic

While latitude was mostly insignificant in the Mediterranean, it was vital in the navigation of the Atlantic. The process described in several sixteenth-century nautical manuals was largely similar to the one recounted by Cotrugli, with an important addition. Pilots, according to Cortés, Rotz, Chaves, Waghenaer and others, would still need to determine which course to follow to voyage from their current location to their destination, taking the winds and currents into account. Their location throughout the journey would still be found by 'taking point', but the process was altered to account for latitude, which was checked using a mariners' astrolabe.

Cortés, as noted by Hewson, discussed an abridged process: if the latitude remained constant, then presumably the course sailed was along an east-west parallel, and 'taking point' was accomplished identically to the process described above: one set of dividers would mark the distance travelled, another would follow a parallel to the (east-west) rhumb, and where they intersected was the (presumed, if the distance had been well-estimated) location of the ship. However, if the latitude was different, the location of the ship would be at the intersection of the direction sailed and the latitude observed, and in this instance, Cortés (though he did not explicitly say so) did not take distance into account, merely found the intersection of the rhumb parallel and latitude.[36]

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[33] Campbell: (1987), p. 439; Gautier Dalché, Patrick: 'Cartes marines, représentation du littoral et perception de l'espace au Moyen Âge. Un état de la question', in *Zones côtières littorales dans le monde Méditerranéen au moyen âge: défense, peuplement, mise en valeur. Actes du colloque international organisé par l'Ecole française de Rome et la Casa de Velázquez*: Rome, 1996, Castrum 7. (Ecole française de Rome et la Casa de Velázquez, 2001), pp. 9-32. p. 12; Pujades i Bataller: (2007), p. 444.

[34] Ibid. p. 445; Gautier Dalché, Patrick: 'L'usage des cartes marines aux xiv^e^ e xv^e^ siècles', in *Spazi, tempi, misure e percorsi nell'Europa del Basso medioevo. Atti del Convegno Storico Internazionale*: Todi, 8 - 11 October, 1995. (Spoleto: Centro italiano di studi sull'alto medioevo, 1996), pp. 97-128. pp. 114-115.

[35] Pujades i Bataller: (2007), p. 446.

[36] Hewson: (1983), pp. 183-184.

A number of other manuals described what to do if the intersection of the rhumb parallel, observed latitude, and distance sailed did not concur, in three different scenarios.[37] The first scenario occurred when the course direction was nearer to north-south than to east-west. Figure 4.3 depicts a course of north-northwest, from origin A to position B as estimated by the compass direction, and the distance sailed. However, the observed latitude was found to be at line C-D. In this scenario, it was thought most likely that the estimated distance was incorrect, instead of the course, and thus point X was taken to be the position of the ship.

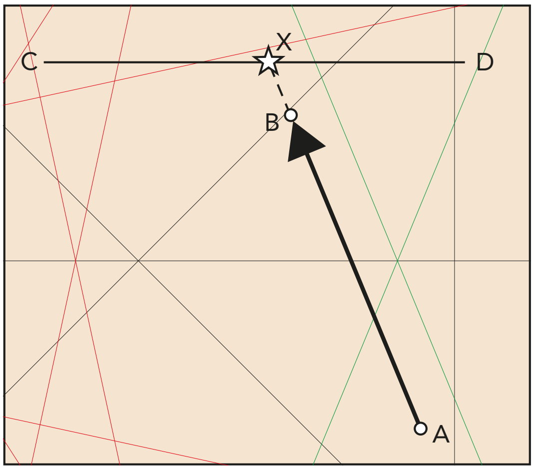

Figure 4.3: First scenario, when the course was more north - south than east - west, the direction and latitude were favoured over distance.

The second scenario occurred when the course sailed was closer to east-west than north-south. Figure 4.4 depicts a course of west-southwest from origin A to position B as estimated by distance and compass. However, the observed latitude was found to be at line C-D. If, as in the first scenario, the course was correct, the position would be point Y, yet the lost distance (segment B-Y) is unlikely, and thus the position instead was determined to be point X, following a correct distance but incorrect course.

The third scenario occurred when the ship was sailing at 45° east or west, halfway between the first two scenarios. Figure 4.5 depicts a course sailed southeast from origin A to estimated position B based on course and distance. The latitude, however, was found to be along the parallel C-D. In this

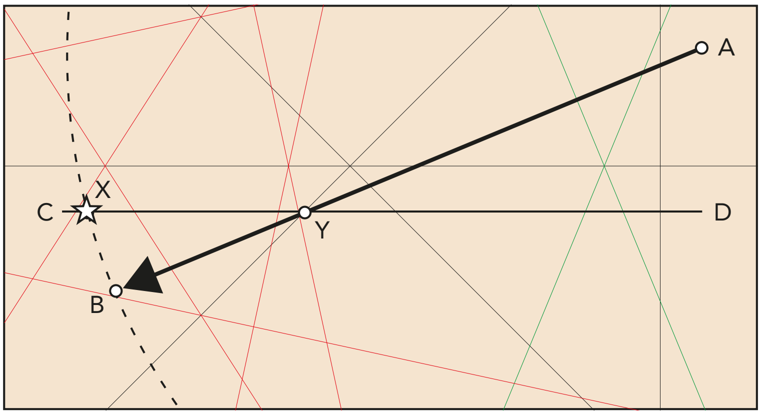

Figure 4.4: Second scenario, when the course was more east - west than north - south, the distance and latitude were favoured over the direction.

[37] The process is described well in Gaspar: (2010), pp. 15-17, and Hewson: (1983), pp. 184-186.

scenario, the position of the ship was then assumed to be point X, halfway between point Z (if the course was incorrect), and point Y (if the distance was incorrect).

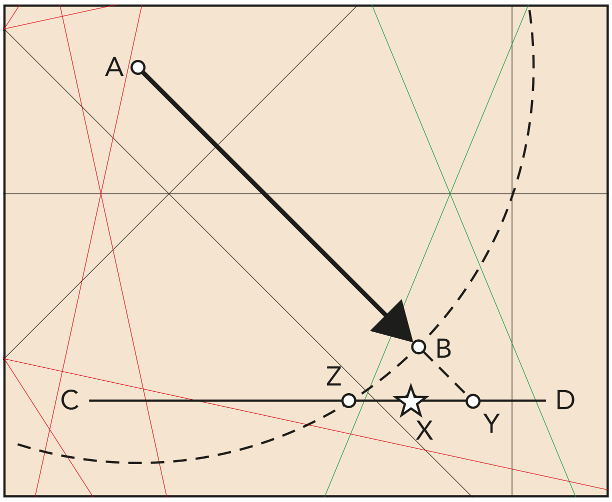

Figure 4.5: Third scenario, when the course was at 45° to the meridians and parallels, only the latitude was favoured, with the estimated position placed halfway between where it would have been if direction had been favoured (first scenario) and if distance had been favoured (second scenario).

This was, of course, only a prescribed method; undoubtedly in a given situation, the pilot, through his experience, might instead make the judgement (due to tacking and leeway of the ship for instance) that the course was incorrect even in the first scenario, or that it was difficult to estimate a reliable distance because of shifting winds. The processes described in the sixteenth-century manuals were largely theoretical and academic, based upon the reality of navigation, but only accounting for the science of the technique, not the art. In reality, like navigation in the Mediterranean, it was the experience of the pilot that allowed a ship to make its course from origin to destination. Hewson noted that these guides must have been misleading, and were condemned by some later navigators, but nevertheless "were generally adopted for want of something better."[38] Moreover, Woodward argued that written "itineraries to plot courses on land and sea were favored over their graphic equivalents".[39]

Toponymy

Many scholars have studied the toponymy of particular portolan maps, but few have argued a synthesis of their overall meaning.[40] Nordenskiöld examined the complete

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[38] Ibid. p. 183.

[39] Woodward, David: 'Cartography and the Renaissance: Continuity and Change', in *The History of Cartography*, ed. by David Woodward, 3 vols. (Chicago: UCP, 2007), vol. 3, pp. 3-24. p. 23.

[40] A comprehensive analysis of the toponyms from numerous charts, while potentially informative about the functions of portolan charts and atlases, would have constituted an entire thesis by itself and was thus beyond the limitations of this study.

toponymy of several maps and concluded that the similarity of their toponyms between the fourteenth and sixteenth centuries demonstrated that nearly all portolan charts were copies with minimal alterations from an original "normal portolano".[41] Campbell called toponyms the "lifeblood of the portolan charts, providing an unrivaled diagnostic source, and one that can readily be quantified", and went on to discuss the ways in which toponymy can be used (with some limitations) to date undated maps and assign provenance in some circumstances.[42] Rosselló i Verger presented the toponymy of several maps and discussed the linguistics of the names between Catalan, Italian, Portuguese, Castilian, Gallic, and Occitan maps.[43]

If the primary function of portolan charts and atlases was for navigation, it must be established how important accurate toponyms were to that function. Additionally, it must be ascertained how quickly newly-built places or discoveries were incorporated onto the charts, and how static or dynamic the toponymy was. In other words, how much care and thought did chart-makers put into their place-names? If toponyms were important to the utility of the map, and the maps were used for navigation, it would be expected that the toponymy would be dynamic and accurate.

Astengo defended the importance of the toponyms as a technical tool of equal importance to the hydrography of a map; they were "the very key whereby contemporary scholars and men of culture could interpret the geographical information in a chart."[44] The toponyms were not merely names of ports: Roselló i Verger argued that the purpose of written portolans and portolan charts was to identify important geographical features, especially when a ship neared their destination.[45] In his toponymic analysis of place-names between Cartagena and Narbonne from forty-four charts and atlases (roughly 120 toponyms each), approximately a third were geographic features labelled in black ink:

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[41] Nordenskiöld, A. E.: *Periplus: An Essay on the Early History of Charts and Sailing-Directions*, trans. by Francis A. Bather (Stockholm: P.A. Norstedt, 1897; repr. New York: Burt Franklin, 1964). p. 45.

[42] Campbell: (1987), pp. 415-428.

[43] Rosselló i Verger, Vicenç M.: 'Portolans procedents de col.leccions espanyoles segles XV-XVII : Catàleg de l'exposició organitzada amb motiu de la 17a Conferència Cartogràfica Internacional i de la Assemblea General de l'Associació Càrtografica Internacional (ICA/ACI) Barcelona' in: Institut Cartogràfic de Catalunya, (Barcelona: Institut Cartogràfic de Catalunya, 1995), pp. 345-371. pp. 345-350.

[44] Astengo, Corradino: 'The Renaissance Chart Tradition in the Mediterranean', in *The History of Cartography*, ed. by David Woodward, 3 vols. (Chicago: UCP, 2007), vol. 3, pp. 174-262. pp. 203-204.

[45] Rosselló i Verger: (1995), p. 345.

natural landmarks easily visible from the sea.[46] It would have been important therefore that these geographical names clearly and precisely matched actual locations on a map. Angelino Dulceti introduced the convention (when ambiguous) of writing the first letter of a place-name at its location, separated from the rest of the word to indicate precisely to what the toponym referred: an example is that of Aigue-Mortes,[47] seen in figure 4.6.

Figure 4.6: '*Aquemorte*' as depicted on the 1339 Angelino Dulceti chart. Dulceti placed the initial 'a' on the island to indicate the precise location of Aigue-Mortes. Image courtesy of: Paris: BN, Rés. Ge. B 696.

Regarding the absorption of new place-names onto charts, Campbell concluded "that it was unpredictable and erratic".[48] Additionally, several important places took a long time to appear, indicating chart-makers were conservative. For example, a castle at Mola di Bari built in 1278 did not appear on charts until the Pizigani brothers' 1373 atlas, and a castle at Pizzo in Calabria was built in 1486, but was not seen until 1512 in a Vesconte Maggiolo atlas.[49] Livorno, founded in the eleventh century, did not appear on maps until Beccari's 1426 chart.[50] Campbell hypothesised reasons for the delays in many circumstances: Livorno, for instance, appeared only after Florence acknowledged its superiority as a port over nearby *Porto Pisano*, which gradually faded from the toponymy of the charts, and Campbell suggested that in many cases, new toponymy would not have been introduced immediately, but only when a place had come of age.[51] Astengo noted however, that Livorno continued to be written in black on most charts in the sixteenth and seventeenth-centuries despite becoming a major entrepôt.[52] Scholars generally agree that most chart-makers were

[46] Ibid.

[47] Oldham, R. D.: 'The Portolan Maps of the Rhône Delta: A Contribution the History of the Sea Charts of the Middle Ages', *The Geographical Journal*, 65: 5 (1925), 403-424. p. 408.

[48] Campbell: (1987), p. 427.

[49] Ibid. pp. 426-427.

[50] Ibid. p. 427.

[51] Ibid.

[52] Astengo: (2007), p. 205.

conservative and hesitant when it came to altering the established toponymy.[53] This attitude was even confirmed by Franciscus Becharius in his 'Address to the Reader'.

Although chart-makers were conservative, the evidence does not fully support Nordenskiöld's assessment that all later charts were copied from an original "normal portolano", for which Taylor and Skelton also argued.[54] New place-names were added, especially in the formative years of the genre. Campbell's study of the introduction of new toponyms showed that Petrus Vesconte introduced twenty-four new names on his 1313 chart in comparison with the *Carte Pisane* and Cortona chart, followed by an additional thirty-nine between his two 1318 atlases, and the c.1325 Perinus Vesconte atlas contributed a further thirty-six. Angelino Dulceti added another seventy-nine on his 1330 chart, and an additional twenty on his 1339 chart.[55] The case studies of Petrus Vesconte and Angelino Dulceti discussed the importance of their toponymic innovation. Campbell noted that after 1367, the addition of new names was distinct between Italian and Catalan maps: by 1385, Italian maps included over one-hundred new names, yet Majorcan maps fewer than thirty.[56] The revolutionary Genoese chart-maker Franciscus Becharius introduced fifty new names in 1403, and his son Battista another seventeen in 1426, but following this, only a further thirty-one were introduced until 1500.[57]

Not every chart-maker introduced several new toponyms however: Campbell's analysis showed that Cresques Abraham's c.1375 Catalan atlas only introduced eleven new names, Rafael Soler's 1385 chart only ten, while the 1409 Virga chart, 1421 Cesanis chart, 1423 Viladestes chart, and 1426 Giroldi atlas contributed only one new place-name each. The pattern in the late-fourteenth and fifteenth-centuries would seem to be that, with a few exceptions, the toponymy of former charts was copied, without much care for improvement. Additionally, as Campbell noted in his study of the relationship of scale to toponymic density, charts generally did not omit names in smaller scale maps, but merely reduced the size of the text. Although it has been argued that this was to retain their navigational utility even at small scales, an alternative reason behind this conservation was

[53] For instance: Nordenskiöld: (1964), p. 45; Winter, Heinrich: 'The True Position of Hermann Wagner in the Controversy of the Compass Chart', *Imago Mundi*, 5 (1948), 21-26. p. 22; Taylor: (1956), p. 113; Astengo: (2007), p. 205; Campbell: (1987), pp. 415, 422.

[54] Nordenskiöld: (1964), p. 45; Skelton, R. A.: *Maps: A Historical Survey of Their Study and Collecting* (Chicago: UCP, 1972). p. 8; Taylor: (1956), p. 113.

[55] Campbell: (1987), p. 416 (Table 19.3).

[56] Ibid. p. 425.

[57] Ibid. p. 416 (Table 19.3).

made clear in the first chapter: the introduction or change of elements (additive or subtractive) added a significant amount of time to the production process, which would have resulted in a loss of potential profits.

Astengo posited that in the sixteenth and seventeenth centuries, the introduction of place-names was largely dependent on the scale of the map: the 1595 Volcio map of the Aegean contained double the number of usual names, and the regional maps in Cavallini's 1652 atlas depicted as many as treble the standard number.[58] More than twice as many toponyms were seen on the 1567 case study of Maggiolo's regional chart as on his standard-scale 1561 and 1563 maps. Astengo noted however, that all of the additional names were written in black, whereas the red toponyms – denoting important places – were rarely altered.[59] Since the publication of his chapter, Campbell has continued his toponymic analysis into the sixteenth and seventeenth centuries, though the list, given the far greater number of dated maps to examine, is far from complete. Cursory results however, seem to indicate that Vesconte Maggiolo, and some of the Olives' family members introduced some new place-names and altered others (though no more than ten to twenty), while others like the prolific atlas-maker Battista Agnese scarcely altered the previous toponymy.[60]

The overall impression derived from the analysis of toponymy is that chart-makers were conservative about adding or changing names: some did make alterations, but many others did not. It would seem that after the initial formation of the genre by the Vesconti and Angelino Dulceti in the early fourteenth-century, the creativity of chart-makers – with some notable exceptions (e.g. Franciscus Becharius) – slowed. Many were content with straightforward copying of earlier work, and their patrons must have been as well. The implications of this upon the function of portolan maps are unclear; logically, pilots would desire as much information as possible, but only if it was accurate. Unlike the modern era, where information can be verified almost instantaneously, chart-makers must have been concerned about the authenticity of incoming information. Therefore, it is unsurprising that they were hesitant to make changes. This attitude is confirmed by Franciscus Becharius' 'Address to the Reader'.[61] Unfortunately, without a more detailed study of the

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[58] Astengo: (2007), p. 205.

[59] Ibid. p. 206.

[60] Campbell: (2013).

[61] The 'Address to the Reader' was discussed in the Becharius case study in Chapter II. A translation is provided in: Kraus, H.P.: *Twenty-Five Manuscripts* (Vaduz, Liechtenstein: Rare Books, 1961). pp. 63-64.

geographical accuracy of toponyms, which would constitute a major research project itself, the nature of toponymy would seem to be unspecific as far as the function of portolan maps.

Future toponymic analysis will undoubtedly answer many questions, such as how quickly chart-makers incorporated new information onto their maps, and how accurate the labelling of the maps was. Although several scholars have discussed toponymy, these studies have generally been limited to comparisons of lists of sequential place-names, and determining when and by whom a new one was incorporated. No scholar has yet studied the accuracy of the placement of each toponym on the maps themselves, to determine if the labelling was accurate. A future study in this regard would prove invaluable in determining whether chart-makers were careful to make accurate maps, or if they nonchalantly replicated names around coastlines.

Hydrographic Evolution

The earliest forty years of surviving portolan charts, beginning with the *Carte Pisane,* dated c.1290, and ending with the 1330 Angelino Dulceti chart, witnessed the introduction of new and updated hydrography.[62] However, after the mid-fourteenth century, changes to make the littoral more accurate were markedly slower than they had been initially. Many specific hydrographic additions and changes were discussed in the case studies in Chapter II, but the intention here is to evaluate the overall extent and nature of the hydrographic evolution within the entire genre. To gain a better insight into the evolution of the hydrography, this section seeks to establish how quickly and accurately new discoveries and coastlines were incorporated into extant maps.

As discussed in the Petrus Vesconte and Angelino Dulceti case studies in Chapter II, several additions were made in the half-century after the earliest surviving map, the *Carte Pisane*. By the time of the 1330 Dulceti chart, the Baltic Sea, and part of the African Atlantic coastline had been added. The successive additions to these two regions, and the incorporation of the Atlantic islands and the New World into the hydrography will be discussed in the following section.

[62] As noted earlier, Pujades has recently suggested that the *Carte Pisane* is not the oldest surviving portolan chart: Pujades i Bataller: (2013). However, this is a highly contentious theory, which requires further scrutiny before the *Carte Pisane* is definitively attributed a later date.

British Isles

On the *Carte Pisane,* Great Britain was depicted as a simple rectangle with a scattering of bays and two river inlets. On the 1313 Vesconte atlas, the next dated map which extended far enough to include it,[63] Britain was markedly improved, showing the Thames estuary and the Cornish peninsula. Ireland made its first appearance on Vesconte's 1320 atlas.[64] While it has been suggested that the Venetian 'Flanders galleys' brought back information about Britain to Venice, Campbell noted that the earliest they had sojourned to Britain was 1319, too late to acquire first-hand information to be included in the 1313 or 1320 atlases.[65] By the time of the 1330 Dulceti chart, the entirety of the British Isles was drawn in a recognisable shape, and included a number of toponyms.

Figure 4.7: The British Isles (only England) depicted on the c.1290 *Carte Pisane*. Image from: Pujades i Bataller (2007) DVD Supplement.

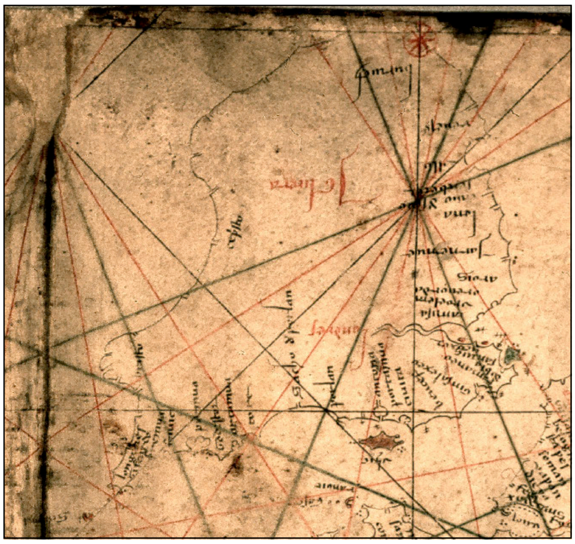

Figure 4.8: The British Isles (only England) depicted in the 1313 Petrus Vesconte atlas (f.6v). Image from: Pujades i Bataller (2007) DVD Supplement.

Andrews discussed the changes that occurred to the shape of the British Isles over the next few centuries, which he divided into different typologies which became more or less popular as they were copied by successive chart-makers. The most popular model, copied well into the sixteenth century, was established by Batista Becharius on his 1426 map.[66]

[63] Britain was also included on an anonymous Genoese map which has been dated to the first quarter of the fourteenth century (Florence: Biblioteca Riccardiana, MS. 3827).

[64] Vesconte, Petrus (1320): Rome: BAV, Pal. Lat. 1362A, f. 7r.

[65] Campbell: (1987), p. 408.

[66] Andrews, Michael C.: 'The British Isles in the Nautical Charts of the XIVth and XVth Centuries', *The Geographical Journal*, 68: 6 (1926), 474-481. pp. 478-479.

Although Andrews made no overall judgements about the changes, the impression gleaned was that most chart-makers copied from earlier models, only rarely making alterations. The case studies corroborate this: both Benincasa and Canepa adopted the model that Batista Becharius (and to an extent his father Franciscus) established, including the description of the hundreds of blessed islands in Galway bay. Several later cartographers, such as Conte Ottomanno Freducci, did the same.

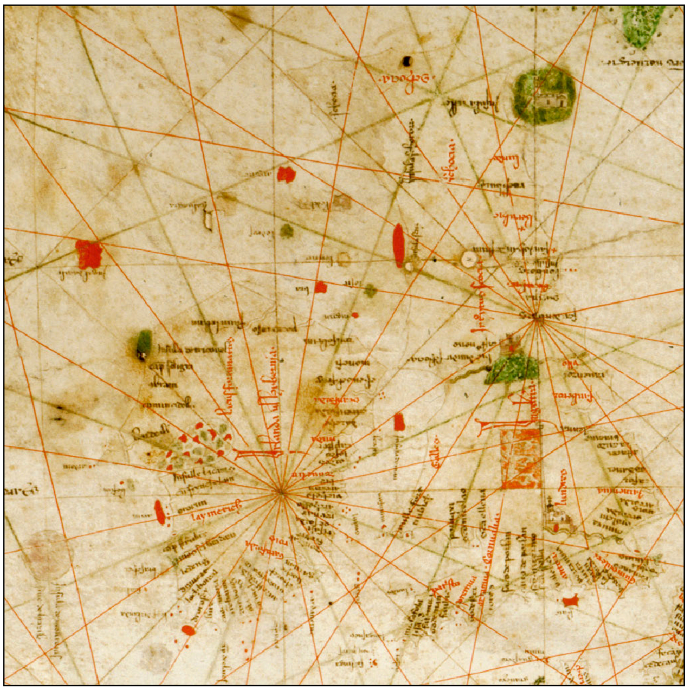

Figure 4.9: The British Isles, as depicted on the 1330 Angelino Dulceti chart. Image from: Pujades i Bataller (2007) DVD Supplement.

Atlantic Africa

The hydrographic development of the Atlantic coast of the African continent can be described as a series of progressive extensions southwards during the fourteenth and fifteenth centuries, as the coast was slowly mapped during several voyages, mostly undertaken by the Portuguese. Campbell provided a table of the successive cartographic extensions of African coastline between 1300 and 1500; the *Carte Pisane* included a short section of the coast as far as Azemmour, as did the 1313 Vesconte atlas, and the 1318 Vesconte atlas was extended to modern Essaouira, at 31° north.[67] Although the Giovanni da Carignano map depicted the African coastline farther south, the hydrography beyond Essaouira was clearly incorrect and had likely been derived from a *mappamundi*. As the case study examined, the 1339 Angelino Dulceti chart depicted the African coastline moderately correctly as far south as Cape Bojador at 26° north, but continued the coastline beyond by an additional degree, though this was probably not based on direct observation.

[67] Campbell: (1987), pp. 411-413.

Until 1434, Cape Bojador remained the farthest extent of the charts, because no ship had been able or willing to sail past. The cape had a hellish reputation amongst seafarers and instilled a terror within them; adhering to medieval notions of the zonal map, Bojador was thought to be the end of the temperate zone and the beginning of the torrid zone, the periphery of good habitable lands and the beginning of the Sea of Darkness and the Inferno from which no traveller could return.[68] Realistically, the cape was a geographical barrier: it is surrounded by dangerous shallows, and prevailing winds blow hard from the northeast, making a return journey difficult. After several attempts, fuelled by a desire to find a sea route around Africa to India, Gil Eannes, under the employ of Prince Henry the Navigator, rounded the cape in 1434, after discovering that more favourable winds were found by venturing farther west into the Atlantic. From then onwards, successive voyages quickly pushed deeper along the African coast, and the Cape of Good Hope was rounded only fifty-four years later (1488) by Bartolomeu Dias.

Although no Portuguese maps from this time survive, their discoveries were quickly adopted by portolan cartographers. The 1448 chart of the Atlantic by Andrea Bianco mapped the African coastline as far as Cap Vert (modern Dakar), which according to Portuguese documents had only been discovered four years earlier by Dinis Dias.[69] Benincasa was quick to map the new discoveries as well: the seventh map in the 1468 atlas mapped the African coast as far south as *cauo mesurado*, near Monrovia, at about 6º north. The Portuguese, led by the explorer Pedro de Sintra, had only explored this far in 1462.[70] Campbell questioned how it was that Benincasa had acquired the information, not simply about the discoveries, but the hydrography itself in only six years, and posited that Roselli or some other unknown chart-maker may have had access to Portuguese charts.[71]

Despite the indication that Portuguese discoveries were disseminated quickly, few portolan charts actually depicted the African coast past Cape Bojador, even in the sixteenth century. Campbell proposed the reason for this was not that the areas were unknown cartographically, but simply that a piece of vellum did not have the space to continue the

68 Prestage, Edgar: *The Portuguese Pioneers* (1933; repr. London: Adam & Charles Black, 1966). p. 54; Cameron, Ian: *Lodestone and Evening Star: The saga of exploration by sea* (London: Hodder and Stoughton, 1965). p. 100; Boxer, Lt. C. R.: *The Portuguese Seabourne Empire 1415-1825*, ed. by J. H. Plumb, The History of Human Society (London: Hutchinson & Co., 1969). p. 26.

69 Prestage: (1966), p. 74.

70 Ibid. pp. 180-184.

71 Campbell, Tony: 'The style and content of Grazioso Benincasa's charts: imitation, innovation and repetition', (2009) <http://www.maphistory.info/benincasa.html> [accessed 1 May 2012].

coastline farther south, without decreasing the scale of the entire map significantly.[72] Benincasa chose to display the additional coastlines by way of an atlas, which did not necessitate altering the scale, but only the addition of an extra map. However, many sixteenth-century maps reduced the scale of the traditional portolan chart area, and instead focused on the Atlantic. The first chart to do so was the c. 1490 'Columbus Chart'.[73] These maps were transitional between portolan charts and the planispheres which, in print form, would become popular commodities. Their small scale most likely precluded their use for navigation, but most were instead used to graphically depict new discoveries.

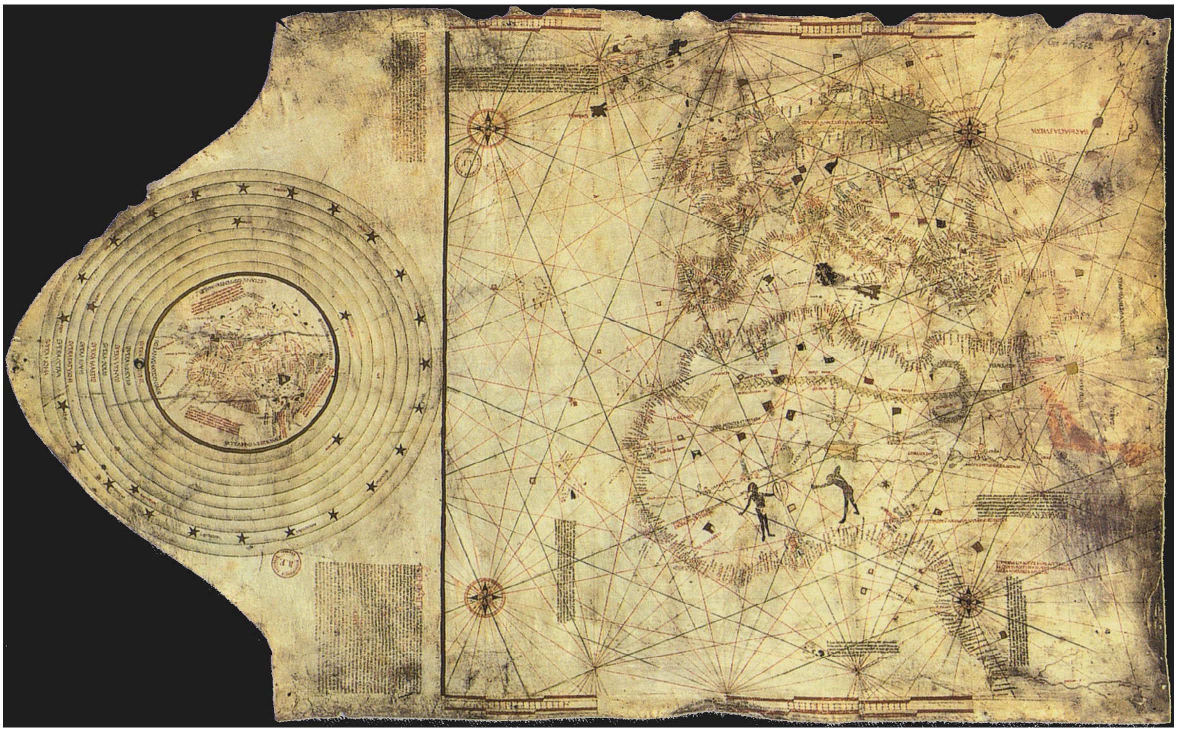

Figure 4.10: The 'Columbus Chart' from c.1490 (Paris: BN, Rés. Ge. AA 562). The map was averaged-sized for a portolan chart (112cm x 70cm), but sacrificed scale in order to include more of Africa and the Atlantic. Image from Wikimedia Commons: <http://upload.wikimedia.org/wikipedia/commons/3/38/ColombusMap.jpg> [Accessed 01 February 2014].

Baltic Sea

The first chart to include the Baltic Sea was the 1330 Angelino Dulceti chart, in the private collection of Prince Corsini in Florence. However, as the case study discussed, it is likely that the Giovanni da Carignano map predated Dulceti's 1330 chart, given that

[72] Ibid.

[73] Paris: BN, Rés. Ge. AA 562.

Figure 4.11: The Baltic, depicted on the 1339 Angelino Dulceti chart. Image from: Pujades i Bataller (2007) DVD Supplement.

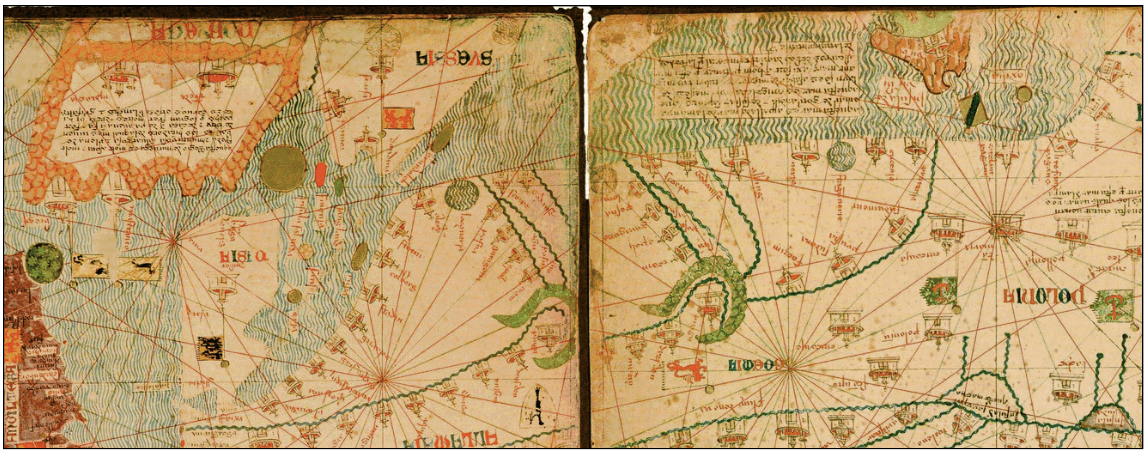

Figure 4.12: The Baltic, depicted on the c.1375 Catalan Atlas. Image from: Pujades i Bataller (2007) DVD Supplement.

documents indicate Carignano died sometime between September 1329 and May 1330.[74] Carignano's depiction of the Baltic showed a moderately accurate Jutland peninsula and several islands to the east which were no doubt a representation of Zeeland. The map also showed the Scandinavian landmass with three peninsulas, and two larger islands which may be Bornholm and Gotland. However, the shape of the sea itself extended too far to the east, ending geographically at what would be the location of Moscow. The depiction of the Baltic by Dulceti in his 1330 and 1339 charts became a more widely-copied hydrography. While the Jutland peninsula was largely similar, the Zeeland islands were depicted smaller than they should have been, and as simple circular islands, but the sea

[74] Ferretto, Arturo: 'Giovanni Mauro de Carignano Rettore de S. Marco, cartografo e scrittore (1291-1329)', *Atti della Società Ligure di Storia Patria*, 52 (1924), 33-52. As cited in: Campbell: (1987), p. 404 (note 258).

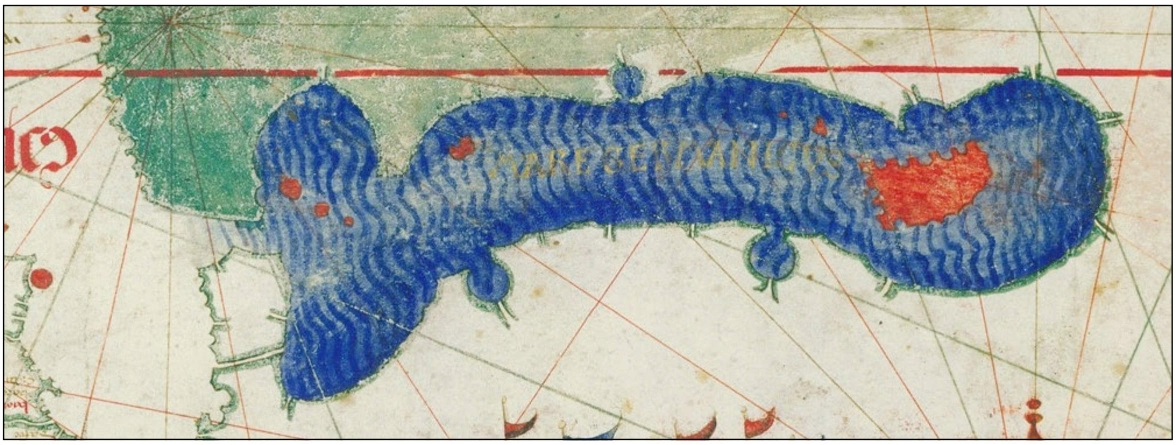

Figure 4.13: The Baltic depicted on the 1502 Cantino Planisphere. Image from Wikimedia Commons: <http://upload.wikimedia.org/wikipedia/commons/9/9c/Cantino_planisphere_%281502%29.jpg> [Accessed 10 October 2013].

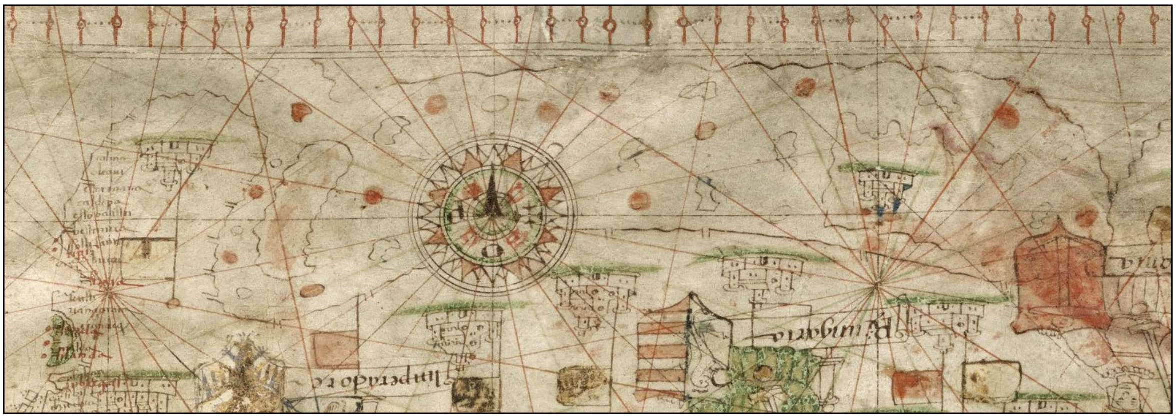

Figure 4.14: The Baltic depicted on the 1533 Jacobus Russus chart. Image from Wikimedia Commons: <http://commons.wikimedia.org/wiki/File:Portolan_by_Jacobus_Russus_of_Medina_1533.jpg> [Accessed 28 May 2009].

itself did not extend nearly as far to the east. Norway was depicted as a rectangular landmass bounded around the edge with mountains and numerous bays, which represented fjords.

A number of portolan charts stopped their hydrography at the top of the Jutland peninsula and did not depict the Baltic at all. When it was depicted, the Baltic was considerably simplified in comparison with the Mediterranean, and the general shape did not change substantially until the sixteenth century. Figures 4.11-4.14 depict the Baltic in a range of maps from the 1339 Dulceti chart to the 1533 Jacobus Russus chart, all of which depicted a simplified sea. From 1323 onwards, the Hanseatic League, which maintained a tight monopoly over the area, denied foreign ships access past their newly established staple ('*kontor*') at Bruges.[75] Because of this, no first-hand information about the Baltic was

[75] Campbell: (1987), p. 410; Scammell, G. V.: *The World Encompassed: The first European maritime empires c. 800-1650* (London: Methuen, 1981). p. 53; Lewis et al.: (1985), pp. 128-130.

disseminated to Mediterranean cartographers via navigators. Campbell noted that marine charts were never a part of the navigational tools of Northern Europeans in the late Middle Ages, and thus it was surprising to see the Baltic depicted as accurately as it was.[76] It is rather curious that, if portolan maps had been so necessary for navigation in the Mediterranean, would not late-medieval Baltic navigators have created their own maps of the area? Schilder and van Egmond theorised that the Baltic and North Sea were more difficult to sail than the Mediterranean, yet while written sailing directions (rutters, known as *leeskaarten*) were created, maps did not appear until the mid-sixteenth century,[77] which casts doubt on the utility of charts for navigation.

Figure 4.15: The Baltic depicted on the 1563 Jacobus Russus chart. Image courtesy of the Fundación Giménez Lorente: <http://fglorente.org/zen/albums/mapas/Jacobo.gif> [Accessed 17 November 2009].

In the mid-sixteenth century, depictions of the Baltic became more accurate. Although the Hanse never had a tradition of mapmaking, the Dutch began mapping the northern European coasts in the late fifteenth century. Schilder and van Egmond noted that the earliest rutter of the North Sea and Baltic was an undated (fifteenth-century) low-German manuscript known as the *Seebuch*, that the earliest printed Dutch rutter dated to 1483-84, and that the earliest 'adequate' charts of northern Europe appeared in about 1550.[78] The union of the Burgundian Netherlands to both Aragon and Castile, and to the Kingdom of Naples, Sicily, and Sardinia, under Charles V, would have fostered the communication necessary for the newly mapped areas to be disseminated to the

[76] Campbell: (1987), p. 409.

[77] Schilder, Günter et al.: 'Maritime Cartography in the Low Countries during the Renaissance', in *The History of Cartography*, ed. by David Woodward, 3 vols. (Chicago: UCP, 2007), vol. 3, pp. 1384-1432. p. 1384.

[78] Ibid. pp. 1384-1385.

Mediterranean. By the second half of the sixteenth century, the Baltic was more accurately depicted. Whereas the 1533 Russus chart (figure 4.14) showed a simplified Baltic derived from the fourteenth-century maps, the 1563 Russus chart (figure 4.15) depicted a markedly more correct Baltic and Scandinavia. By the seventeenth century, the Baltic appeared largely correct, based on the diffusion of the cartographic efforts of the Low Countries.

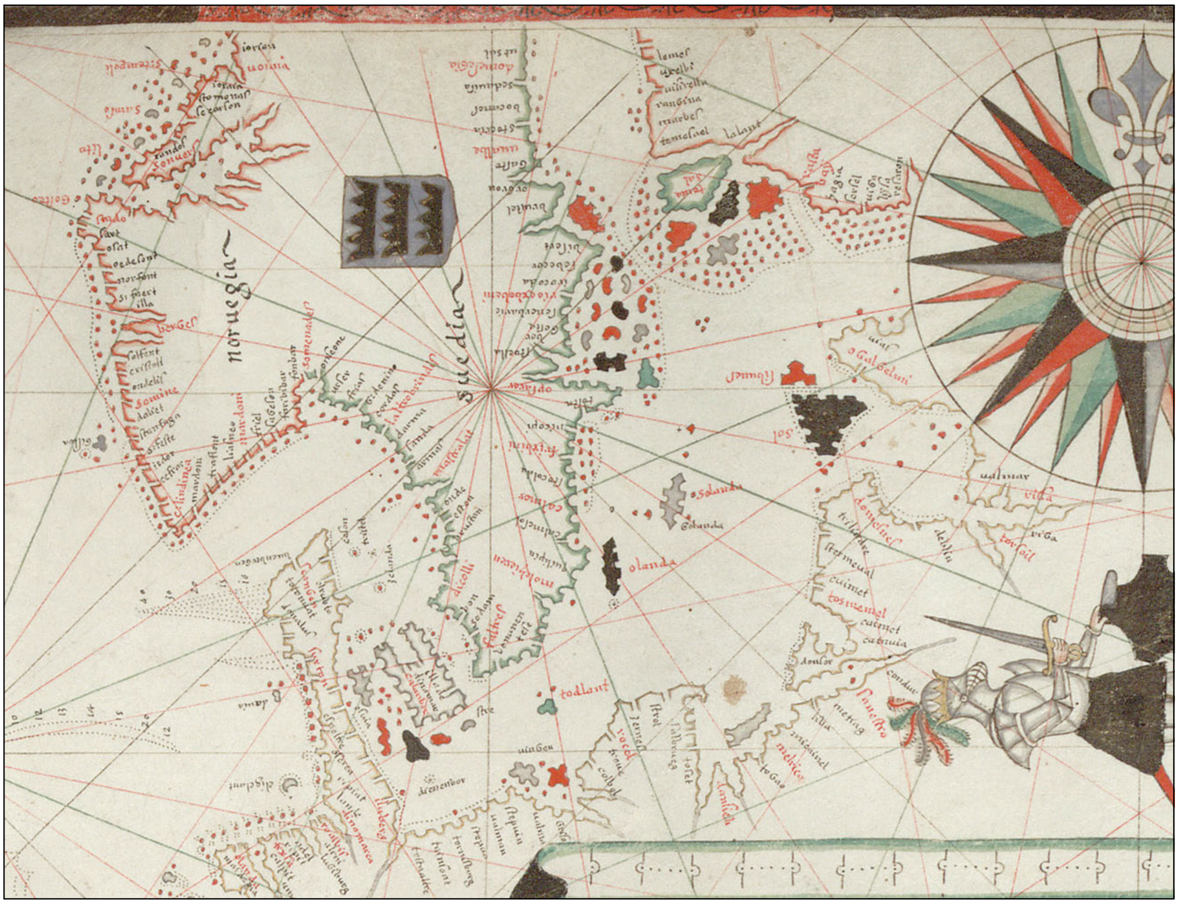

Figure 4.16: The Baltic depicted on the 1602 Joan Oliva chart, using significantly updated cartographic information. Image courtesy of the Huntington Library: <http://digitalassets.lib.berkeley.edu/ds/huntington/images//000562B.jpg> [Accessed 31 July 2013].

Atlantic Islands

The discovery and mapping of island archipelagos of the Atlantic have been discussed in the relevant case studies presented in Chapter II, but a summation of their mapping is worth reiteration here. The first map to include the Canary Islands was the 1339 Angelino Dulceti chart, on which was depicted Lanzerote, the Isla de Lobos, and Fuerteventura. The Dulceti chart was also the first to depict a group of islands north of the Canaries, which were labelled 'Insulle sancti brandanj siue puelarum' (the islands of St Brendan or of maidens). This chain of islands was copied in many future portolan maps, including the 1403 Franciscus Becharius chart. Although Fernández Duro identified these islands as the Azores, Armando Cortesão argued that these islands were the earliest depiction of the

Madeiras.[79] Cortesão's proposition seems the more likely: on the 1403 Becharius chart, the islands at the south of the chain match quite accurately to the Madeira archipelago, and Porto Santo and the Islas Desertas are even labelled as such (see figure 3.3.3).

The 1403 Becharius chart, like many others, depicted the 'Fortunate Isles of St Brendan', a chain of islands from the Madeiras in the south to what might have been the Azores in the north. If these were the earliest depictions of the Azores however, they were positioned incorrectly. Cortesão nevertheless argued that Terceira of the Azores was first depicted on the 1367 Pizigani chart as the island of '*bracir*'.[80] The Azores were not officially discovered until 1427 by Portuguese explorer Diogo da Silves, and were first mapped in their correct location on the 1439 Gabriel de Valseca chart, which included the following legend next to the islands: "Aquestas illes foran trobades per Diego de Sivils, pelot del rey de Portogall, an l'ay m cccc xxvii".[81]

The Cape Verde islands were first definitively depicted in the two 1468 Benincasa atlases. According to slightly disagreeing documents, the Cape Verdes were discovered a few years before 1460 by Genoese-born explorer Antonio da Noli, and in 1466, King Alfonso V made him governor of the island of Santiago.[82] Cortesão however, argued that the islands were first partially represented on the 1413 Mecia de Viladestes chart as two mirrored crescent-shaped islands. Given that the islands lay much farther south than Cape Bojador, the rounding of which is well-documented, it is unlikely the islands were based on any actual information, and were more likely based on legend.

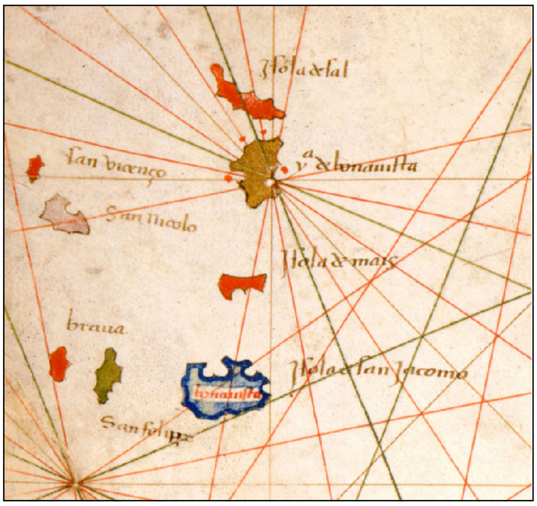

Figure 4.17: The Cape Verde islands, first depicted on the 1468 Gratiosus Benincasa atlas (London: BL, Add. MS. 6390, f.8v) Image from: Pujades i Bataller (2007) DVD Supplement.

[79] Cortesão, Armando: *The Nautical Chart of 1424 and the Early Discovery and Cartographical Representation of America: A Study on the History of Early Navigation and Cartography* (Coimbra: University of Coimbra, 1954). p. 47. Also cited in: Campbell: (1987), p. 410 (note 294).

[80] Ibid. pp. 410-411 (note 295).

[81] Translation: "These islands were discovered by Diogo de Silves, pilot of the King of Portugal, in the year 1427". Pujades i Bataller, Ramón J.: *La Carta de Gabriel de Valseca de 1439*, trans. by Catalina Gironda Arguimbau (Barcelona: Lumen Artis Ediciones, 2009). p. 358.

[82] Prestage: (1966), pp. 143-144.

Mythical Islands

In addition to these real island archipelagoes, a number of islands also appeared on maps which are more difficult to attribute to a real location. Dulceti was the first to include three large island-landmasses north of Scotland: the '*insula scitilano*', '*insula orchania*', and the '*insula chatenes*'. *Scitilano*, which appeared rather large and ovular, was often included on other maps, and Campbell noted that it might have been one of the earliest depictions of Iceland.[83] Well known to many historians of cartography are the large islands known as *Antillia* and *Salvaga* which were first drawn in the middle of the North Atlantic on the 1424 chart by Zuane Pizzigano.[84] The islands are most likely related to an early medieval Spanish tale of the Isle of Seven Cities: according to a legend on the 1492 Behaim globe,

Figure 4.18: The 1424 Zuane Pizzigano chart of the Atlantic (Minneapolis: JFBL, B1424mPi), the first to show the large islands of *Antillia* (red) and *Salvaga* (blue, named '*satanazo*' on this chart). Image courtesy of the James Ford Bell Library.

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[83] Campbell: (1987), p. 414.

[84] Minneapolis: James Ford Bell Library, B1424mPi.

after a Moorish invasion in the early eighth century, an archbishop and six bishops with several followers set sail to escape, and arrived on *Antillia*.[85] After the 1424 map, these islands were often placed on many maps until the early sixteenth century, and they appear to have been taken quite seriously by mariners and their patrons. Between 1462 and 1487, Donald Johnson identified eight unsuccessful Portuguese voyages taken to discover the islands, and in 1493, Peter Martyr d'Anghiera (a Spanish humanist, cartographer and historian), wrote that the depiction of the islands on early maps demonstrated that mariners had reached the Indies several decades earlier; the same was thought by Antonio Galvão fifty years later.[86]

A number of scholars have theorised that the islands were more than the uncorroborated placement of myth, but actual encounters with the coastline of the New World. Cortesão, in the first major study of the 1424 chart, argued that "Antilia and the other westernmost isles figured on the 1424 Chart are intended to represent the easternmost part of the American hemisphere".[87] A study by E. G. R. Taylor argued that Cortesão was correct in his conclusions: she demonstrated that rare easterly winds could have blown a large ship off course that could have then reached the eastern coasts of Labrador and Newfoundland, which she argued were then interpreted as small islands.[88] Kelley discussed the toponymy attributed to *Antillia* and *Salvaga* and how they might have described real geographical places, but concluded that if they were an early representation of the New World, the islands were more likely to have corresponded to Nova Scotia and the Chesapeake.[89]

If a ship or ships had unintentionally been blown off course into the deep Atlantic, and had managed to return, it is questionable how the crew would share the experience of their voyage, or, in other words, how would their experiences be transferred onto a map? At the time, there was no conception of another continent across the Atlantic except Asia, yet there was a belief in the legend of the Antilles, thus it is unsurprising they were utilised to tangibly frame their experience of seeing new lands. Whether *Antillia* and *Salvaga* were

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[85] Johnson, Donald S.: *Phantom Islands of the Atlantic* (Fredericton, New Brunswick: Goose Lane, 1994). pp. 91-94.

[86] Ibid. pp. 95, 109.

[87] Cortesão: (1954), p. 3.

[88] Taylor, E. G. R.: 'Imaginary Islands: A Problem Solved', *The Geographical Journal*, 130: 1 (1964), 105-109. pp. 105-109.

[89] Kelley Jr., James E.: 'Non-Mediterranean Influences that Shaped the Atlantic in the Early Portolan Charts', *Imago Mundi*, 31 (1979), 18-35. pp. 27-33.

included from the accounts of unknown voyages, or simply the incorporation of myth, they were quickly incorporated into the hydrography of many portolans, appearing even on sixteenth-century maps.

Another mythical island, the '*insula de braçir*' (*Brazilia*), was commonly depicted off the western coast of Ireland, was always circular, and sometimes had a scalloped edge or bar through the middle. The first portolan map to depict the island was the 1330 Angelino Dulceti chart, and it appeared on many portolan maps, including the c.1375 Catalan Atlas. Johnson discussed the mythology behind the island, and linked it to four different Celtic legends that developed in the sixth century.[90] However, the island was thought to be real, and several voyages were undertaken to discover *Brazilia*. Johnson noted that in 1480, an English ship set sail under the direction of John Jay Jr. and Thomas Lyde from Bristol, to find and chart the "insulam de Brasylie," but after nine months returned without success. A second expedition was organised the following year, but also returned unsuccessfully.[91] The island continued to appear on charts well into the seventeenth century, including on Blaeu's 1676 world map, and Johnson noted the last map to include the island – much reduced in size and labelled 'Brazil Rock' – was dated 1865, though he did not identify on which map this was.[92]

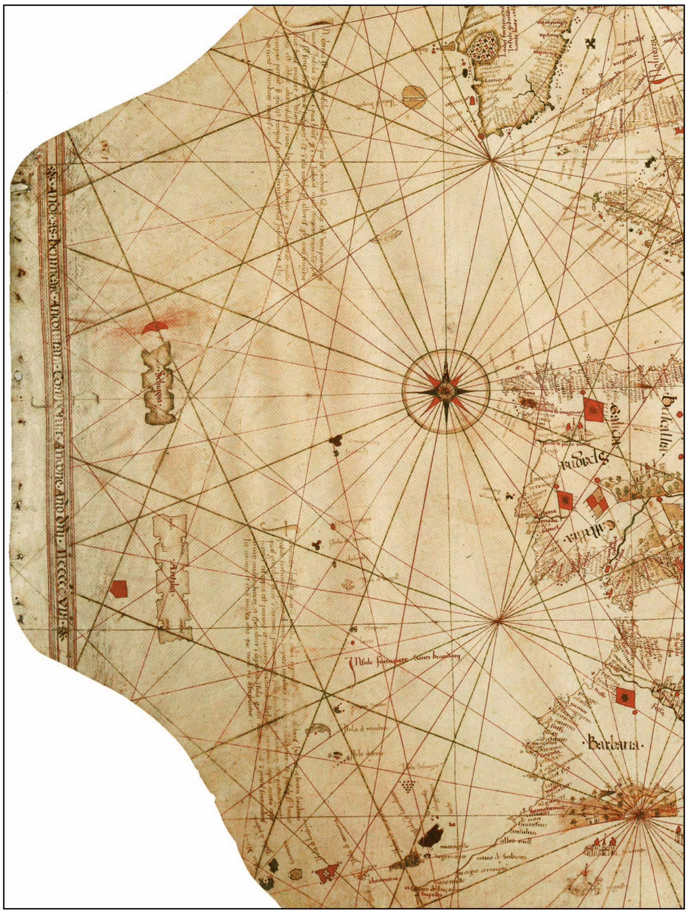

Figure 4.19: *Antillia* and *Salvaga* depicted on the 1508 Andrea Benincasa chart. Image courtesy of the Fundación Giménez Lorente: <http://fglorente.org/zen/albums/mapas/Benincasa.gif> [Accessed 17 November 2009].

[90] Johnson: (1994), p. 115.

[91] Ibid. p. 116.

[92] Ibid. p. 125.

Conclusion

The evidence would suggest that most portolan chart-makers were generally enthusiastic about making hydrographic additions to their maps. New discoveries, such as the extension of the African Atlantic coastline southwards in the fifteenth century, or the discovery of the Atlantic archipelagos, were adopted quickly onto portolan maps. When, in the case of the Baltic, adequate charting was unavailable, the cartographers adhered to old patterns, even though many probably knew they were not accurate depictions. When new information became available, it was utilised.

However, it remains to be established that chart-makers altered previously-mapped coastlines to make beneficial changes; most simply copied the work of their predecessors. The general impression gleaned from Chapter I was that straightforward copying was the fastest (and by extension the most profitable) way to make a map, and even minor changes were time-consuming. The analysis of the seven case studies confirmed that the portolan cartographers adopted new discoveries rapidly, but were insouciant about changing their established hydrography, notwithstanding the exception of Franciscus Becharius.

The shape of the Italian peninsula appears to have changed dramatically in the first three decades of the genre, i.e. between the c.1290 *Carte Pisane* and the 1320 Vesconte atlas, which, like the changes in the British Isles discussed above is unsurprising. Dulceti's coastline of the peninsula nineteen years later appeared largely similar, although with a reduced length of the Adriatic, which, as shown in figure 3.2.7, was more correct. Comparison between the 1403 Becharius and 1339 Dulceti chart showed a close similarity, except that Becharius, as he noted in his 'Address to the Reader', shortened the north-south length of Sardinia by about 10%. The similarity of the coastlines however, indicates that it was, if not a direct copy, only a few iterations away. The same can be said for the comparison between Becharius's coastline, Roselli's 1465 chart, Benincasa's 1468 atlas, and Becharius' 1403 chart, which share a nearly identical coastline, except for the area around Ancona, Venice, and the Kvarner Bay, which Benincasa deepened significantly to make it easier to visualise its numerous islands.

Comparison of the Italian peninsula between the Canepa and Roselli charts established their similarity to such an extent that, in addition to their decorative styles, it could be surmised that Canepa trained as an apprentice in Roselli's atelier. Finally, comparison between the 1567 chart by Jacopo Maggiolo and the other case studies interestingly did not establish any connection; indeed, the shape of Sardinia in Maggiolo's chart indicates that he did not use any map which followed the corrections made by Becharius. Thus, there is evidence both of a tradition of copying and of some changes being made, such as those done by Benincasa to the Kvarner Bay, and Becharius to Sardinia. To settle the question of how significantly chart-makers altered established coastlines, or adhered to old ones would require a significant cartometric study. Though a daunting task, examining sections of coastlines from hundreds of maps to produce a typological evolution would demonstrate the extent to which maps were copied from one another, and the exact development of their hydrography.

Hydrographic Accuracy

The hydrography of a portolan chart was one of its most important technical aspects. Understanding the drawing of the littoral, and its change over time, is directly related to the function of the map; if a portolan chart or atlas was to be used for navigation, the coastlines would have had to be drawn to aid navigators as best as possible. It would have been necessary that geographic features, such as headlands, rivers, bays etc., would be clear, recognisable, and correctly located, and hazards such as shoals and rocks, precisely identified. Cortés recommended only copying charts on which all of the coasts, ports and islands were "well-painted and approved to be true".[93] Alternatively, in maps made for a more didactic, scholarly, or aesthetic function, while hydrographic accuracy might have been desirable, it was not requisite to the utility of the map. This section will discuss the nature of the hydrography of the portolan maps: its accuracy, change over time, and how useful it might have been for navigators.

At first glance, the shape of the Mediterranean of even the earliest portolan charts is recognisable. To historians of cartography, it is well-known that the inception of the portolan map represented a significant advancement in the geographic depiction of the known world; earlier *mappaemundi*, and world maps, such as the 1154 map by Al-Idrisi, cannot compare with portolan charts in the geographical accuracy of the Mediterranean, Black Sea, and Atlantic coastlines. As geographic depictions, the correctness of portolan maps – and the printed planispheres which were in many ways their cartographic progeny

[93] "Asi son menester padrones delas costas puertos y yslas que se han de pintar enla carta. Y han se de procurar los mas approbados y verdaderos que se hallen." Cortés: (1551), p. 128 (f. 63r).

– would not be exceeded until the eighteenth century, when surveys through triangulation and scientifically-measured latitude and longitude mapped the coastlines systematically.[94]

Most studies of the accuracy and evolution of the hydrography of portolan maps have involved the presentation of tracings of coastlines of particular features from a selection of maps. Campbell warned however, that this method is subjective and has only limited value because the significance of the change in coastlines is conjectural.[95] Indeed, the method is not quantifiable, and prone to the dangers of subjectivity and bias, even subconsciously. Yet, it remains the primary method by which several academics have discussed the coastlines, their variability, and evolution. Nordenskiöld presented a series of tracings of the Crimean peninsula, the mouth of the Nile, the Strait of Gibraltar, and the shape of Majorca,[96] and Caraci published tracings of the same regions with the addition of Scotland from a different selection of six maps.[97] Cortesão presented and discussed a series of drawings of the shapes of the mythical islands of *Antillia* and *Salvaga*, and the earliest depictions of the Cape Verde Islands.[98] Andrews, in a series of articles, depicted coastline tracings and discussed the evolution of the shapes of Scotland and the British Isles, and classified the differing shapes into distinct categories.[99] Unfortunately, many of these drawings are crude, without scale, and were presented side-by-side, not superimposed upon each other, all of which made minute variations difficult to see, a problem which Campbell also identified.[100] Additionally, in several of the studies, the selection of charts seemed arbitrary, leaving one questioning whether the results might be different had alternative maps been used.

This method, despite its limitations, allows a single aspect of several maps to be visualised simultaneously by aiding the viewer to conceptualise only a single aspect of the charts (their coastline) by removing everything else (toponymy, decoration, rhumb lines etc.). Hydrographic comparisons in the seven case studies were useful in demonstrating the

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[94] See: Astengo: (2007), p. 199.

[95] Campbell: (1987), p. 403.

[96] Nordenskiöld: (1964), p. 23.

[97] Caraci, Giuseppe: 'The Italian Cartographers of the Benincasa and Freducci Families and the So-Called Borgiana Map of the Vatican Library', *Imago Mundi*, 10 (1953), 23-45. p. 41.

[98] Cortesão, Armando: 'The North Atlantic Nautical Chart of 1424', *Imago Mundi*, 10 (1953), 1-13. pp. 9-12.

[99] Andrews, Michael C.: 'The Boundary between Scotland and England in the Portolan Charts', *Proceedings of the Society of Antiquaries of Scotland*, 60 (1925-26), 36-66; ---: (1926); Andrews, Michael C.: 'Scotland in the Portolan Charts', *Scottish Geographical Magazine*, 42: 3, 4, 5 (1926), 129-153, 193-213, 293-306.

[100] Campbell: (1987), pp. 403-404.

variation in coastlines between chart-makers, the relationship between them, and perhaps most interestingly, that some maps made by the same maker did not share identical hydrography, indicating the process used to construct the maps.

More fundamentally however, the term 'accuracy' is controversial in the study of cartography. It is not possible for any map to include all relevant information and present it in such a way that everyone will understand it equally, or even in the same way as the cartographer. Monmonier discussed the generalisations inherent in cartography, in which cartographers select what information to present and what to suppress, and simplify the selected information, displace it geographically, or visually smooth or enhance it to better communicate the intent of the cartographer.[101] Robinson and Petchenik discussed the map as a communication system "between the cartographer and the map percipient", which has been filtered through the conception of the cartographer and the map viewer.[102] J. B. Harley argued that "the steps in making a map – selection, omission, simplification, classification, the creation of hierarchies, and 'symbolization' – are all inherently rhetorical."[103] Bearing this in mind, objective accuracy is impossible for cartography to achieve. However, a map may be able to be correct enough for different purposes; if portolan charts were intended to be used for navigation, then their subjective accuracy would be based upon their ability to be used for that purpose.

Furthermore, the use of the term 'accuracy' to discuss early cartography must not be clouded by anachronistic conceptions. The modern world, filled with maps constructed from decades of scientific surveying and/or satellite imagery, has the ability to cloud the judgement of historians concerning the accuracy of maps from the past. Portolan maps, in comparison with many that came before, presented the world in a more realistic manner, yet in comparison with modern maps, might be viewed as archaic and incorrect. Woodward, in a discussion of the focus historians of early modern cartography have made on scientific progress, argued "this view of mapmaking in the Renaissance as a model of metrical progress has blinkered our vision by focusing only on maps that support such improvements in geographical accuracy. In so doing we tend to impose our own present-day standards of 'accurate maps' onto the past, usually forming a self-perpetuating canon

[101] Monmonier, Mark: *How to Lie with Maps*, 2nd edn. (Chicago: UCP, 1996). pp. 25-30.

[102] Robinson, Arthur H. et al.: *The Nature of Maps: Essays toward Understanding Maps and Mapping* (Chicago: UCP, 1976). pp. 23-42.

[103] Harley, J. B.: 'Deconstructing the Map', *Cartographica*, 26: 2 (1989), 1-20. p. 11.

of 'great maps' that conform to our limited notions of positional accuracy."[104] However, anachronistic conceptions about the portolan chart may obscure theories of their function in the opposite manner; Scott Westrem, in a discussion of portolan maps, noted that the "'familiarity' to the modern eye of maps used by navigators… may be deceptive, causing us to see them only as 'precursors' of the 'realistic' cartography of today, thus distracting us from some of their essential medieval qualities".[105]

As a result, there is not much that the direct comparison of portolan chart coastlines with modern maps can reveal, except to show that maps were evolving closer or further away from reality. In other words, comparing a single medieval coastline with its modern equivalent, and making a judgement that the medieval one was was 'incorrect' is not useful; to the medieval cartographer, a portolan map might have been as correct as anyone knew, perfectly presenting information so as to be of great use to the percipient. However, the comparison of a chronology of medieval coastlines could demonstrate how they were evolving, which in turn might indicate the intentions of the cartographers, and the functions of the maps themselves.

Figures 4.20 through 4.24 depict the coastlines of the c. 1290 *Carte Pisane*, the 1339 Angelino Dulceti chart, the 1403 Franciscus Becharius chart, the 1502 Cantino Planisphere, and the 1644 Alberto de Stefano chart, superimposed upon a loximuthal projection of the Mediterranean.[106] One can see considerable improvement in the hydrography between the *Carte Pisane* and the 1339 Dulceti chart, and further development by Becharius in 1403. While the Cantino Planisphere, a copy of the '*padrão real*' (master chart) upon which the Portuguese recorded their discoveries in the New World and Africa, depicted a more accurately-proportioned Iberian and French Atlantic coastline, it made no changes to the Mediterranean, and the Black Sea continued to be drawn too large. The 1644 Alberto de Stefano chart is an example of much later charts from the genre and was certainly a decorative map, rather than one for navigation.

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[104] Woodward: (2007), p. 7.

[105] Westrem, Scott D.: *The Hereford Map: A Transcription and Translation of the Legends with Commentary* (Turnhout: Brepols, 2001). xxxviii n. 60. Cited in: Morse, Victoria: 'The Role of Maps in Later Medieval Society: Twelfth to Fourteenth Century', in *The History of Cartography*, ed. by David Woodward, 3 vols. (Chicago: UCP, 2007), vol. 3, pp. 25-52. p. 36 (note 68).

[106] It has been established that loximuthal projections are most likely the best projection to fit to the empirically-derived construction of portolan charts based on measured distances and compass directions. See Gaspar, Joaquim Alves: 'Dead reckoning and magnetic declination: unveiling the mystery of portolan charts', *e-Perimetron*, 3: 4 (2008), 191-203. pp. 193-195 The projection used was centred at 40ºN, 0ºE.

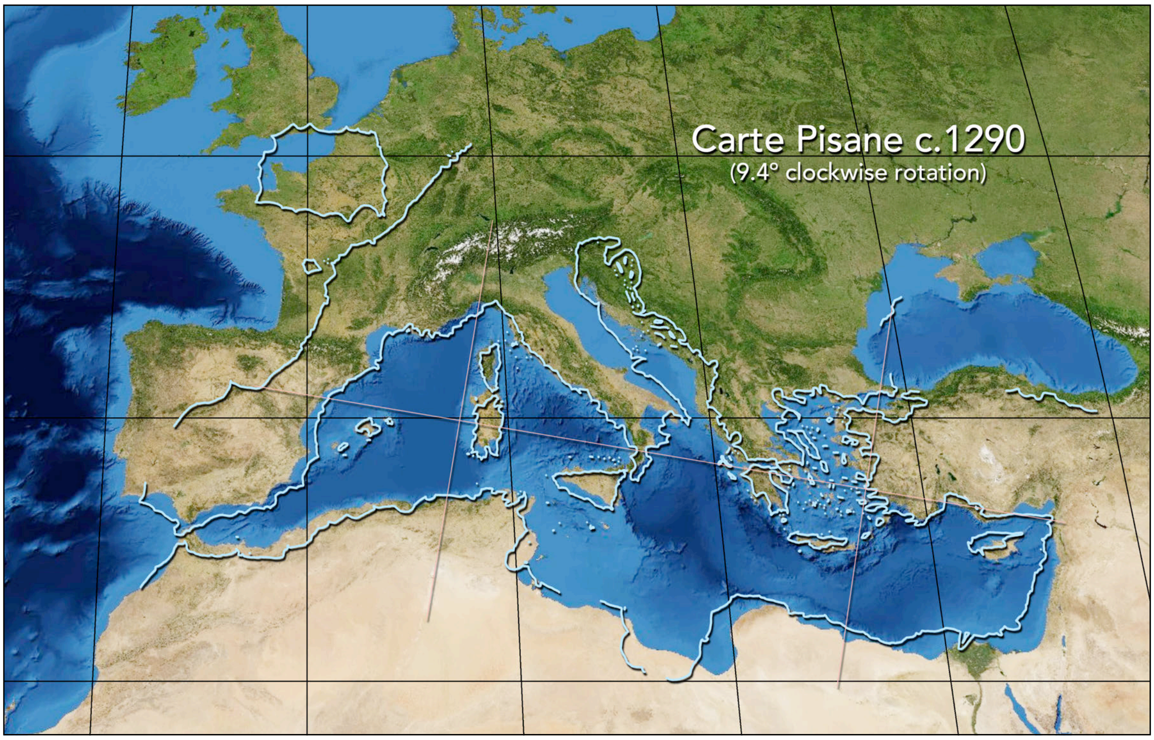

Figure 4.20: Superimposition of the coastline from the c.1290 *Carte Pisane* over satellite imagery on a loximuthal projection. Digital tracing was made using an image from Wikimedia Commons: <http://commons.wikimedia.org/wiki/File:Carte_Pisane_Portolan.jpg> [Accessed 2 February 2014]. Underlying map provided by Stephanie Oliver using ArcGIS.

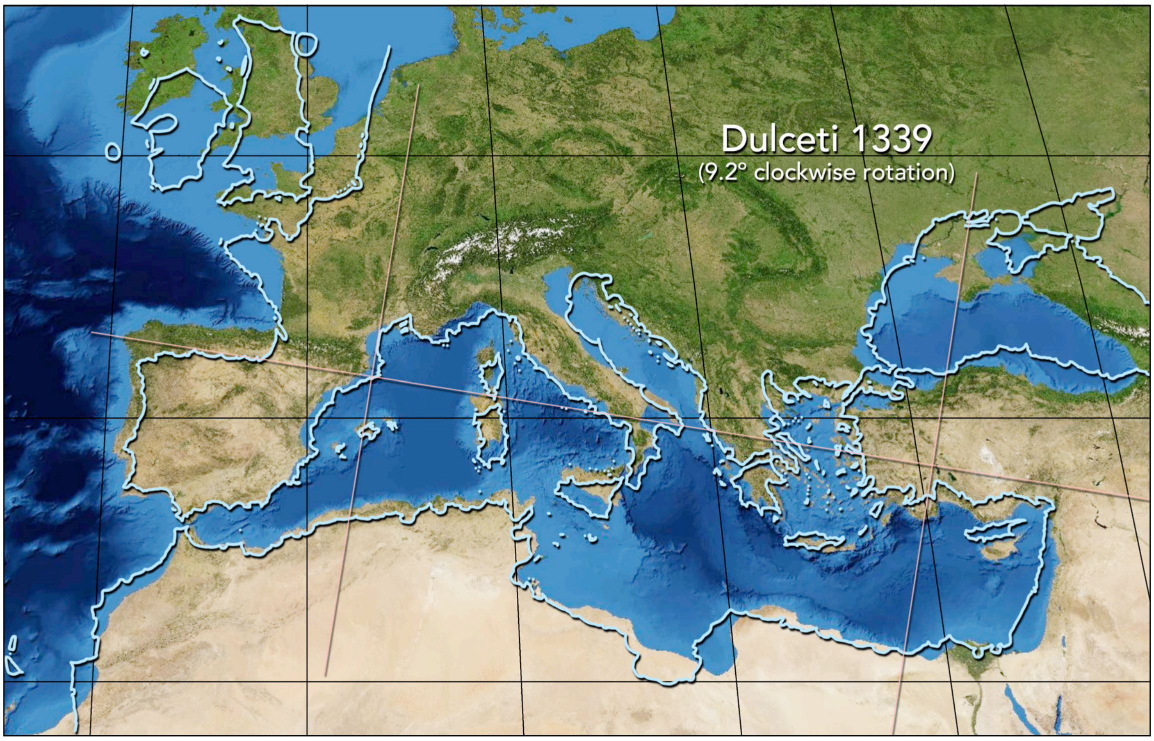

Figure 4.21: Superimposition of the coastline from the 1339 Angelino Dulceti chart over satellite imagery on a loximuthal projection. Digital tracing was made using an image courtesy of the Bibliothèque Nationale de France. Underlying map provided by Stephanie Oliver using ArcGIS.

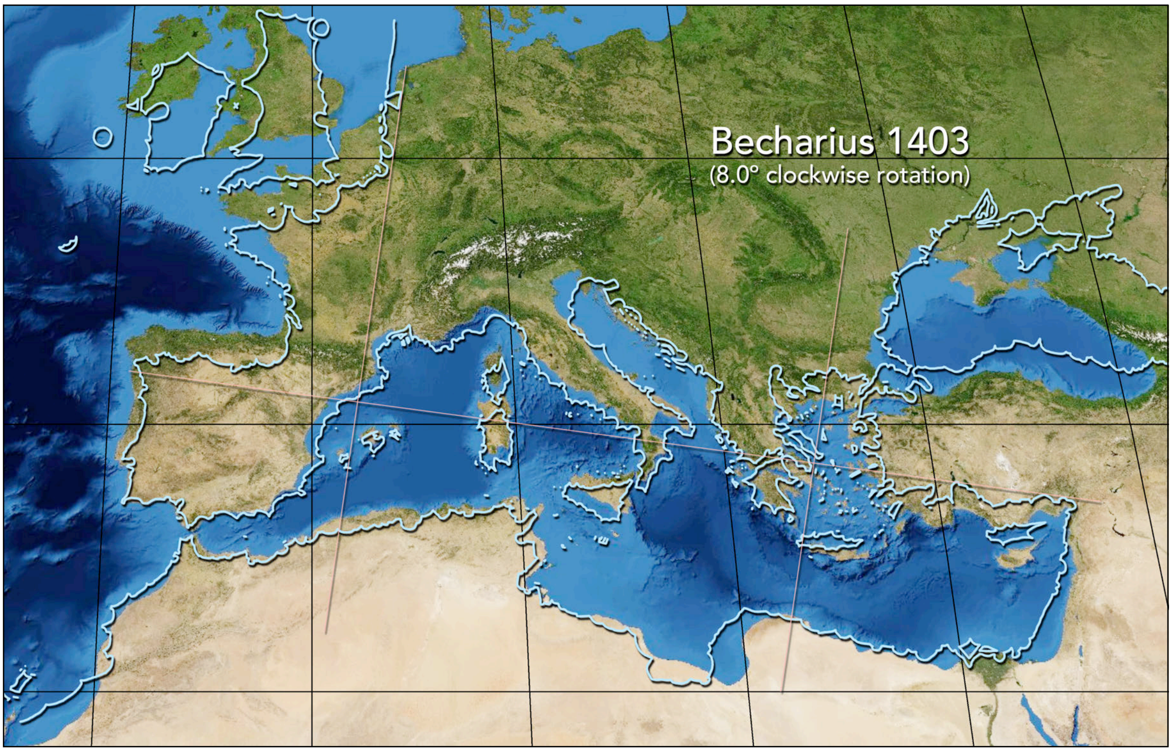

Figure 4.22: Superimposition of the coastline from the 1403 Franciscus Becharius chart over satellite imagery on a loximuthal projection. Digital tracing was made using an image courtesy of the Beinecke Library, available at: <http://brbl-zoom.library.yale.edu/viewer/1027149> [Accessed 12 November 2013]. Underlying map provided by Stephanie Oliver using ArcGIS.

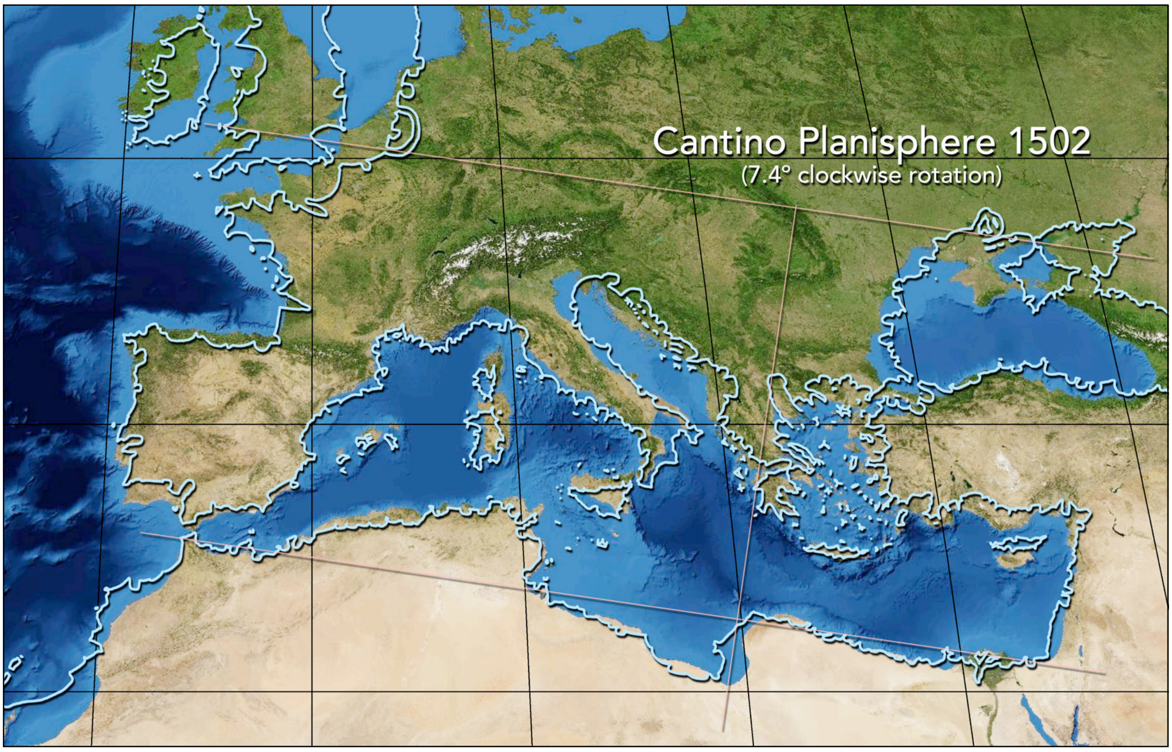

Figure 4.23: Superimposition of the coastline from the 1502 Cantino Planisphere over satellite imagery on a loximuthal projection. Digital tracing was made using an image from Wikimedia Commons: <http://upload.wikimedia.org/wikipedia/commons/9/9c/Cantino_planisphere_%281502%29.jpg> [Accessed 10 October 2013]. Underlying map provided by Stephanie Oliver using ArcGIS.

Figure 4.24: Superimposition of the coastline from the 1644 Alberto de Stefano chart (Greenwich: NMM, G230:1/14) over satellite imagery on a loximuthal projection. Digital tracing was made using an image courtesy of the National Maritime Museum, and available to view here: <http://collections.rmg.co.uk/collections/objects/540310.html> [Accessed 2 February 2014]. Underlying map provided by Stephanie Oliver using ArcGIS.

Although a general evolution can be seen from comparison between these five maps, only a major detailed cartometric study of tens, if not hundreds, of maps would be able to clearly show hydrographic evolution or devolution, but such a study was beyond the scope of this thesis. Future cartometric research could confirm that the coastlines were seen to be consistently drawn with precision and diligence, and their communication of hydrographic information improved, which would denote a navigational utility. Alternatively, if the hydrography was seen to become less realistic over time, or if the information was nonchalantly or variably presented, it would suggest that precise mapping of coastline was not important to their function. For the purposes of this thesis, assessment of the practical utility of the hydrography will therefore be based on three aspects: variations in scale, the size of the scale, and variance in the magnetic deviation.

Variations in Scale

Although the shape of the Mediterranean in portolan maps appears correct to many modern observers, cartometric measurements taken from portolan maps has revealed numerous inconsistencies in scale. The exaggerated size of the Black Sea have been discussed by several scholars, including Nordenskiöld and Campbell.[107] Kelley observed that it was regularly drawn about 25% larger than it should have been, and noted that the error was never corrected, despite an indication it was a known problem, because the 1409 Albertin de Virga chart depicted a different scale bar for the Black Sea.[108] Conversely, the Atlantic was drawn considerably smaller than it should have been. Kelley estimated it was 18% smaller than it should have been, though Campbell noted it might have been closer to 30%.[109] As the case study explained, the scale of the Atlantic was partially corrected by Franciscus Becharius in his 1403 chart, but continued to remain too small by perhaps 10%. Only in the sixteenth century, when latitude scales were incorporated, was this error slowly corrected.

As discussed in Chapter I, the length of the portolan mile has been a matter of debate in the past, although many scholars would now settle on an average of 1.25 km per *miglia* for the Mediterranean.[110] Appendix I presents the measurements Pujades made on 110 charts and atlases in his 2007 study, from which the length of the portolan mile was calculated for each measurement according to the length of the scale bar on the map itself.[111] The overall results are presented in the table below. While the overall average of 1.241 km per *miglia* confirmed the 1.25 km estimate made by Campbell, there was significant variation in the calculated values between each map. Furthermore, the calculations for the Black Sea, averaging 1.033 km per *miglia*, supported the well-known impression that it was drawn significantly larger than it actually was, and the opposite was confirmed for the Atlantic coastlines, which were drawn smaller than usual at 1.447 km per *miglia*.

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[107] Nordenskiöld: (1964), p. 20; Campbell: (1987), p. 389.

[108] Kelley Jr., James E.: 'The Oldest Portlan Chart in the New World', *Terrae Incognitae: Annals of the Society for the History of Discoveries*, 9 (1977), 22-48. p. 48.

[109] Ibid. ; Campbell: (1987), p. 414.

[110] Ibid. p. 389.

[111] The measurements were found in: Pujades i Bataller: (2007), pp. 204-209. Pujades did not make the calculations of the length of the *miglia* according to each map however.

	Average for Charts	*Average for Atlases*	*Combined Average*	*Combined Range*
Barcelona - Marseilles (339km)	1.237 km	1.252 km	1.242 km	0.833 - 1.483
Capo Spartivento, Calabria - Tripoli (608km)	1.243 km	1.264 km	1.252 km	1.048 - 1.468
Cabo de San Antonio, Valencia - Beirut (3190km)	1.215 km	N/A	1.215 km	1.095 - 1.384
Constanța, Romania - Trabzon, Turkey (975km)	1.019 km	1.051 km	1.033 km	0.837 - 1.427
Pointe Saint-Mathieu, Brittany - Calais (560km)	1.443 km	1.453 km	1.447 km	1.167 - 1.891
Overall	1.233 km	1.255 km	1.241 km	0.833 - 1.891

The variability in the scale between the Mediterranean, Black Sea, and Atlantic did not necessarily preclude the utility of the map. If a full-sized chart was used for navigational purposes, it was probably limited to a particular region or trade route. Nevertheless, it is curious that little effort was made to correct the problem. More problematic was the variation in scale between the charts themselves. Overall, the length of a single *miglia*, which should have been a fixed value, varied from 0.833 km to 1.891 km: 67% and 152% of the average value respectively. However, even within individual regions, there was considerable variability. The length in the Black Sea ranged from as low as 0.837 km/*miglia* to as high as 1.427, a 70% difference. The Atlantic coastline meanwhile, varied from a low of 1.167 km/*miglia*, to a high of 1.891, a 62% difference.[112]

Within the Mediterranean, the measurements between Barcelona and Marseilles revealed a lowest value of 0.833 km/*miglia* and a high of 1.483 km, a 78% difference. Between Calabria and Tripoli, the measurements calculated the lowest scale to be 1.048 km, and the highest to be 1.468 km/*miglia*, a 40% difference. As measured across the length of the Mediterranean, from Valencia to Beirut, the lowest calculated value was was 1.095 km/*miglia*, while the highest was 1.384 km/*miglia*, a 38% difference. In all of these scale inconsistencies, there did not appear to be any correlation between a chart's

[112] The distance measured on the *Carte Pisane* from Brittany to Calais resulted in a *miglia* length of 2.751 km, but because it is the oldest extant chart with a rudimentary Atlantic coastline, the value was considered an outlier, and not counted in the averages.

provenance and its scale; in other words, there was no indication that Catalan maps had smaller scales for example whereas Venetian ones had larger scales.

The calculations in Appendix I also indicated the scale sometimes varied widely between measurements within the Mediterranean on individual charts and atlases. The 1413 Mecia de Viladestes chart varied in scale from 1.304 km/*miglia* between Barcelona and Marseilles, to 1.171 km/*miglia* from Valencia to Beirut, a 10% difference. The 1456 Petrus Vesconte chart revealed a difference of 1.396km/miglia from Barcelona and Marseielles, to 1.237 km/*miglia* across the length of the Mediterranean, an 11% difference.

The drastic inconsistencies between maps would have made it difficult for them to have been used for navigation. As discussed above, one of the dividers would have been used to take a measurement from the scale bar corresponding to the estimated distance sailed. The inconsistency of their scales, both between maps and on the same map would have made this process of 'taking point' incredibly difficult, compounded by the fact that the pilot was already using an estimated distance in the first place. If, for example, a pilot had estimated a distance of fifty *miglia* sailed since the last '*apuntar*', and measured fifty out on the scale of his chart, that measured length on the scale might equal as many as seventy *miglia* in reality, or as few as thirty. Unless the pilot knew exactly how to compensate for them, these inconsistencies would have made the maps practically useless for navigation.

Size of Scale

There was however, an even more fundamental problem with the scale of the portolan maps. Gautier Dalché concluded that the small scale of portolan maps would not have made them effective charts for navigation.[113] The table of measurements provided by Pujades for the fourteenth and fifteenth centuries confirms that nearly every chart and atlas was drawn at between 0.9 and 1.2 cm per 50 *miglia*.[114] There were only a few exceptions to this: the 1403 Becharius chart was drawn at 1.6 cm per 50 *miglia*, as was a 1468 Benincasa chart, and five atlases had a particular sheet or two drawn at 2.0 - 2.2 cm per 50 *miglia*, which were either of the Black or Adriatic Seas. Although no one has published any substantial tables of this cartometric information, most charts and atlases in the sixteenth and seventeenth centuries continued to be drawn at the same scales, or even smaller, if the

[113] Gautier Dalché: (2001), pp. 13, 25-27.

[114] Pujades i Bataller: (2007), pp. 204-209

entire Atlantic and New World coastlines were included. The 1567 Jacopo Maggiolo chart, drawn at 4.5 cm per 50 *miglia*, seems to have been a rare exception.

Cotrugli implied that the process of 'taking point' was meant to be done every hour, or at least the speed and direction should be noted every hour: "… et intende<u>re</u> quante meglia hai nauigato p<u>er</u> tal uento p<u>er</u> hore et qua<u>n</u>te hore, et quanti p<u>er</u> tal uento".[115] Although Cortés did not write how often one should take point, it has been assumed it would have been at least once per day, if not every time the course was altered.[116] Ships of the fourteenth and early fifteenth centuries could manage only between one and perhaps five knots at the very most. Pryor calculated the speed of fourteenth-century *naves* and galleys from documented voyages, and concluded that one knot upwind and two knots downwind were fair estimates of speed.[117] By the late fifteenth century, lateen-rigged caravels and carracks were able to manage a little more speed, especially in the strong winds of the Atlantic; in the journal of Christopher Columbus' first voyage, he estimated that during some 24-hour periods the ships had travelled as far as sixty leagues, but on other days as few as ten or fifteen.[118]

As discussed in Chapter I, one league on the portolan charts was equal to four portolan *miglia*. Thus, if Columbus used an average-scaled chart, during his best days of sailing, the ship might have moved as much as four centimetres, but on a bad day, under one. In the fourteenth century, a ship moving at (a generous) three knots would have moved 4.4 *miglia* each hour, or 106.7 *miglia* in twenty-four hours. That would equate to about two centimetres on a standard-scale portolan map every day (moving at a fast pace), or less than a millimetre every hour. Given their scale, 'taking point' was not possible every hour on a standard chart. It might have been possible to do so once per day, but unless the ship maintained a constant or near-constant course, the errors that would have accumulated would have made using a chart for navigation almost useless. The process of '*apuntar*' would only have worked on charts drawn at a much larger scale, yet there is very little evidence that large-scale portolan charts existed in any quantity.

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115 Translation: "… and understand how many miles you have navigated through each wind (rhumb) each hour and how many hours, and how many through each wind (rhumb)". Transcription provided in: Kelley Jr.: (2000), p. 26.

116 Hewson: (1983), p. 183.

117 Pryor: (1988), pp. 51-52.

118 Columbus, Christopher: *The Journal of Christopher Columbus*, trans. by Cecil Jane, ed. by L. A. Vigneras (London: Anthony Blond & The Orion Press, 1960). pp. 6-22.

Angular Skew

Since the sixteenth century, it was understood that the Mediterranean Sea as depicted on portolan maps was incorrectly skewed anticlockwise. Simply put, the axis of the Mediterranean, commonly measured between Gibraltar and Antioch – which exist at the same latitude – was rotated by between eight and twelve degrees anticlockwise. Lanman compared nineteen maps dated from 1300 to 1610 with palaeomagnetic data, and concluded that this rotation of the axis was a result of the magnetic declination at the time, a conclusion with which Gaspar agreed.[119] Indeed, the angle of magnetic declination around the time of the inception of portolan maps was about 8º in the western and central Mediterranean, but changed over time.

Kelley proposed a possible alternative reason for the skew: if the original chart had been made using a compilation of distances between several points, but not directions, the difference in length between the two latitude parallels of the northern Mediterranean and southern Mediterranean (because of the sphericity of the Earth), would cause an anticlockwise skew of the Mediterranean.[120] Astengo noted from a personal conversation with historian of cartography David Woodward that a further possible reason might have been simply to include the British Isles more easily on a rectangular parchment,[121] but this seems rather unlikely. Most scholars, including Astengo and Pujades agree with Lanman's conclusion that the skew was caused by magnetic declination.

Even after the skew was recognised in the early to mid-sixteenth century by navigators taking numerous latitude measurements, very few portolan chart-makers corrected this abnormality until the seventeenth century, even though some planispheres and Atlantic plane charts seem to have been corrected.[122] Astengo discussed a number of portolan charts and atlases that did adopt the change: one notable map was the 1618 chart by Joan Oliva, which depicted the Mediterranean twice, once as normal with the typical skew of the Mediterranean, and once again with the magnetic declination taken into account (figure 4.25).[123] Another was the the Alberto de Stefano chart mentioned above

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[119] Lanman: (1987), pp. 23-32, 50 ; Gaspar: (2010), p. 24.

[120] Kelley Jr., James E.: 'Perspectives on the Origins and Uses of the Portolan Charts', *Cartographica*, 32: 3 (1995), 1-16. pp. 5-6.

[121] Astengo: (2007), p. 194.

[122] Ibid.

[123] Rimini: Biblioteca Civica Gambalunga, Sala Manoscritti (no known individual record number).

(figure 4.24), on which a legend noted: “This chart was made to give a correction of one rhumb”.[124] Although the problem was recognised however, many maps were not corrected.

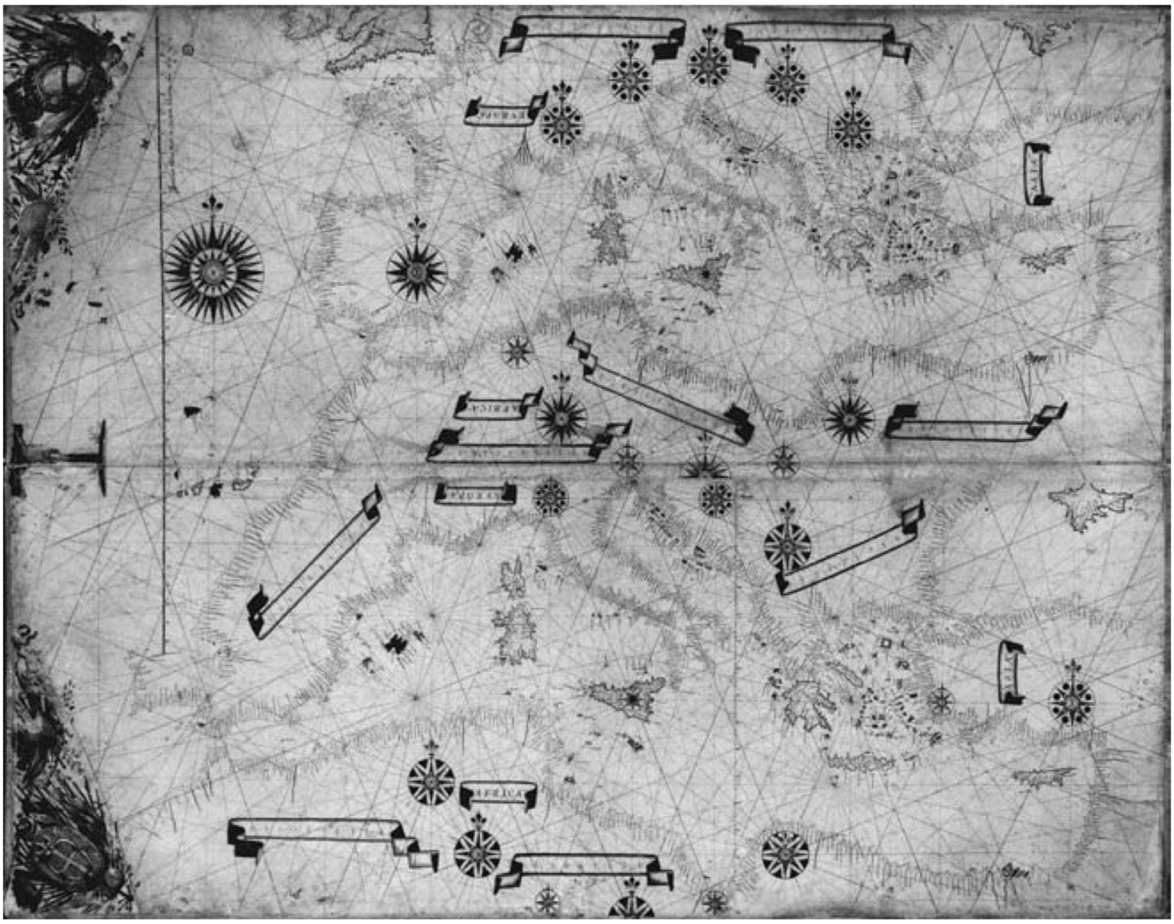


Figure 4.25: The Joan Oliva ‘Double Chart’ of the Mediterranean from 1618 (Rimini: Biblioteca Civica Gambalunga), showing the normal portolan chart orientation above, and the corrected orientation below. Image from: Astengo (2007), p. 198.

Because Lanman’s study only examined charts and not atlases, it was decided to measure the angular deviation of the individual maps in the 1468 Benincasa atlas, to determine if this every map in the atlas followed the expected angular skew. This was accomplished by taking measurements of two well-known places parallel to a rhumb angle (every 11.25º), and comparing that angle with their true angle. The results of these measurements are shown in the following table:

124 Translation in: Ibid. pp. 197-198. Unfortunately, no image of the Alberto de Stefano chart (Greenwich: NMM, G230:1/14) was detailed enough to provide a Latin inscription.

Map Plate (folio)	**Toponyms** (current name & toponym if significantly different)	**Angle on Map** (parallel rhumb line followed)	**True Angle** (Google Earth)	**Angle of Rotation**	**Expected deviation for mid-15th cen.** (from geomagnetic model CALS7K2 by Korte and Constable 2005)
Plate 2 (ff. 3v-4r) (Black Sea)	Constantinople - Sukhumi (*sanastopoli*)	67.5	74.1	6.6º ACW	0.9º ACW - 1.8º CW
Plate 2 (ff. 3v-4r) (East Med)	Policastro - Beirut	90	97.3	7.3º ACW	1.75º ACW - 0.8º CW
Plate 3 (ff. 4v-5r)	Ravenna - S. Rhodes	112.5	119.9	7.4º ACW	4.4º - 1.0º ACW
Plate 4 (ff. 5v-6r)	Trafalgar - Piombino	56.25	56.9	0.65º ACW	3.9º - 4.5º ACW
Plate 5 (ff. 6v-7r)	(Just east of) Oporto - Dieppe	33.75	33.6	0.15º CW	2.7º - 3.1º ACW
Plate 6 (ff. 7v-8r)	Cape Bojador - Tarifa	33.75	35.4	1.65 ACW	2.5º - 3.9º ACW
Plate 7 (ff. 8v-9r)	(N. of) Cape Verde (N15º30', W16º40') - Cape of St. Anne (Sierra Leone)	157.5	155.0	2.5 CW	2.3º - 2.2º ACW

The results of the measurements of angles from the 1468 Benincasa atlas seem to moderately concur with the expected skewing of the Mediterranean: i.e., a greater angle of rotation anticlockwise farther east. At the time of Lanman's publication, the only palaeomagnetic data for the fifteenth century had been taken from lava flows on Ischia in the Bay of Naples and thus could not show regional variations, but revealed an approximately 8º anticlockwise rotation.[125] More recent models by Korte and Constable, based on numerous geomagnetic samples, are now able to show regional variation.[126] As shown in the table above, the angles of derivation do not match the expected angles from the Korte and Constable model, except on the last map of the coastline of Africa between Cape Bojador and Sierra Leone. For all but the last map, these results were not unexpected: they are simply an indication that Benincasa was not compiling his maps

[125] Lanman: (1987), pp. 27-28.

[126] The field model developed by Korte and Constable is known as CALS7K, the data from which covers the last 7000 years. See: Korte, M. et al.: 'Continuous geomagnetic field models for the past 7 millennia: 2. CALS7K', *Geochemistry, Geophysics, Geosystems*, 6: 2 (2005), 1-18 The calculations above were made using an online calculator using this data set: http://physics.gallaudet.edu/magfield/CALS7Kfield.html <accessed 29 January 2014>.

according to recent compass readings and magnetic variation. However, it would appear that the final map of Africa was based on recently acquired compass directions; this too is unsurprising because the region in question had only recently been mapped by the Portuguese, and was never a part of the standard mapped portolan chart area, which was skewed from the beginning.

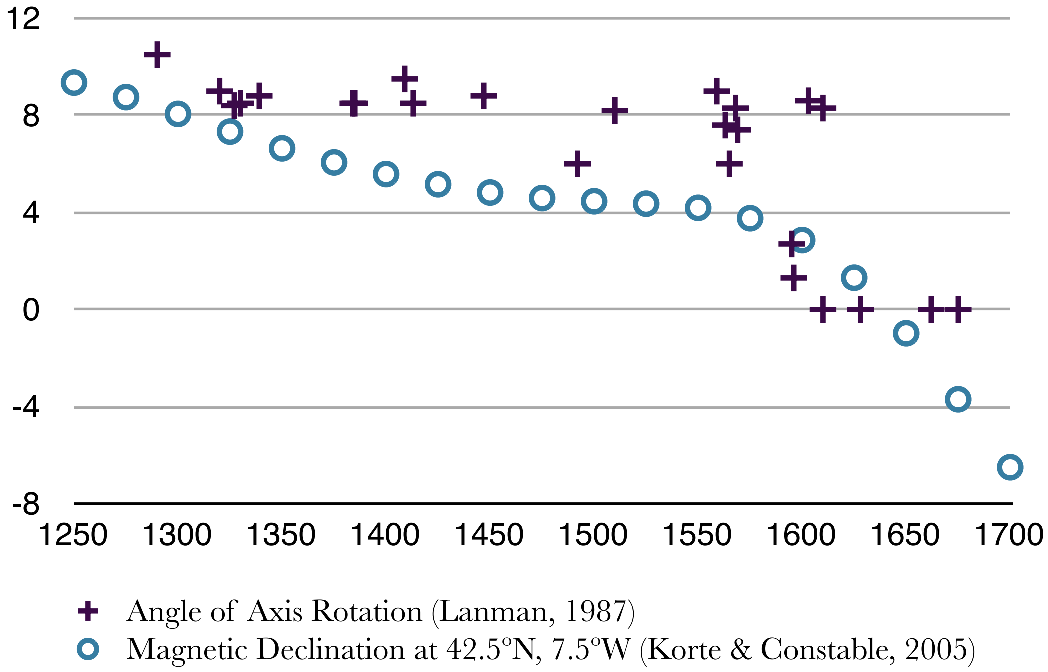
Evidence concerning the skew of the hydrography suggests that the magnetic declination remained largely unchanged over time. A cartometric study of twenty-six charts between 1339 and 1508 by Scott Allen Loomer concluded that portolan maps were not constructed according to the magnetic declination at the time of their construction, and simply adopted the established angular skew that had been present from the earliest maps.[127] At the time of Loomer's study however, there was no data for the period before 1300, so he was unable to confirm whether the skew of 8-10º observed on the charts was the declination at the time of their initial creation. According to Korte and Constable's data set, in 1250 (which was probably around the time of the inception of the portolan map)[128] the magnetic declination was approximately 8.6º anticlockwise on Majorca, 9.5º in Genoa, 9.6º in Pisa, and 9.7º in Venice, all potential areas for the invention of the map genre, and all about the same angle at which the earliest charts were constructed.

The following histogram depicts the angles of angular skew of the Mediterranean as measured by Lanman, and compares them with the magnetic declination measured in the Western Mediterranean (42.5ºN, 7.5ºW, equidistant from the major production centres of portolan charts: Venice, Genoa, and Majorca) from Korte and Constable's CALS7K data set. The results show a slow decline in the measured declination over the time period, though the charts remained skewed at between roughly 7º and 9º until the late sixteenth century.

[127] Loomer, Scott Allen: 'A Cartometric Analysis of Portolan Charts: A Search for Methodology' (Unblished Doctoral Thesis, University of Wisconsin - Madison, 1987). p. 167.

[128] The earliest reference to a nautical chart is within the c.1270 *Gesta Sancti Ludovici*.

Figure 4.26: The Angle of Rotation Compared to Magnetic Declination



A future analysis of more specific regional cartometric data compared with regional magnetic declination might enable more specific conclusions to be drawn. In general however, it would seem that portolan maps, for three centuries after their inception, were drawn to the original compass measurements made in the thirteenth century, with no effort made to improve them. However, according to the process of 'taking point', the direction of the ship, as measured with a compass, was a vital stage in determining the course followed and the next best course to take. Like their variability in scale, the fact that the maps' angle of declination did not match the true angle of declination at the time, would have made them difficult to use. Perhaps navigators at the time were taught to make certain adjustments to their compasses depending on where they were, but the fact that there never seemed to be an effort by cartographers to provide corrected maps until much later in the life of the genre, indicates that they were unconcerned with the needs of ships' navigators. The nonchalance of chart-makers to produce maps useful for navigation suggests that navigational utility was unnecessary to their function.

Conclusion

Chapter III presented a number of pieces of contemporaneous evidence which indicated a number of portolan maps were owned by navigators, and documents which directly noted, or from which it could be inferred, that portolan maps were used at sea for navigation. The aim of this first part of this chapter was to evaluate just how functional portolan maps would have been for navigation in the process known as 'taking point'. This method, which varied depending on whether latitude was a factor, appeared in several nautical manuals in the sixteenth century, though curiously only in one dating from the fifteenth. While a full cartometric study was beyond the scope of the thesis, the usefulness of portolan maps was assessed through their two characteristics of toponymy and hydrography.

The evaluation of toponymy found that chart-makers were hesitant to make changes, and largely copied the maps from their predecessors without making significant alterations. The likely reason for this, as determined by the first chapter, was because making alterations to the copied exemplar was difficult and time-consuming. This conservatism was also witnessed in the hydrographic change; although cartographers appeared to have been enthusiastic about adding new coastlines to their mapped world, once these coastlines appeared, they did not change readily. Concerning the sixteenth and seventeenth centuries, David Woodward wrote: "those graphics [utilitarian aspects] that were employed tended to be extremely conservative and follow models that had already been established in the Middle Ages. The portolan charts changed little as long as they were confined to the Mediterranean".[129] Only rarely, such as in the case of Franciscus Becharius, did chart-makers make drastic changes to their maps to aid navigators.

In most circumstances, chart-makers did not appear to have been particularly concerned with making useful maps for for navigation, even when aspects were known to be incorrect. This was confirmed by the analysis of the variation in scale, which was found to be inconsistent both between different maps, and within the same maps. Similarly, the magnetic deviation established on the earliest charts was not corrected until the late sixteenth century, despite a gradual change in declination. As a result, portolan charts became more incorrect over time, and the fact that there was no significant effort to

[129] Woodward: (2007), p. 23.

improve them indicates that chart-makers were unconcerned about the nautical utility of their maps.

Furthermore, the size of the scale of nearly all surviving portolan maps precludes their usefulness for the navigational process of 'taking point'. Unless a great number of maps were made at a much larger scale (of which there is no indication), charts at the scales of 0.9-1.2 cm per *miglia*, on which a day's travel might measure less than a centimetre, would not have been large enough to use. While proponents of the 'utilitarian hypothesis' might argue that different, large-scaled models were copied for maps used at sea, the first chapter established that it is unlikely cartographers would have used different hydrographic models for navigational maps and luxury maps. From an assessment of their utilitarian practicalities, portolan maps could not have been used for navigation.

IV: Part II, The Administrative, Scholarly, and Aesthetic Map

The first part of this chapter evaluated the utilitarian aspects of portolan maps – their toponymy and hydrography – in order to assess how navigationally-useful they could have been. Although more research is needed, the conclusion reached was that, disregarding how objectively 'accurate' the maps were, chart-makers were not only conservative about change, but uninterested in producing maps that could have been used for navigation. Hopefully, future academic study will be able to settle the question of the maps' navigational utility to a greater extent. The purpose of this second part of Chapter IV is to discuss the alternative functions these maps might have had: as maps used for an administrative or reference purpose; as spiritual, scholarly, and didactic instruments; and as aesthetic objets d'art. These three alternative categories of function correlate well to Harley and Woodward's proposition that maps had the following purposes: "geographical wayfinding and inventory of the real world; sacred and cosmological representation of the world of the religious mind; the promotion of secular ideology; and an aesthetic function or decoration."[130]

Administrative and Reference Maps

Harley and Woodward's first category, that of geographical way-finding and inventory, is the most utilitarian of their proposed functions. Though their ability to be used successfully for navigation has been brought into doubt, a second utilitarian function of portolan charts could have been to 'inventory' the known maritime world, and present it in such a way that it could be used for a number of different purposes, from planning a trade journey, to the documentation of new discoveries, to simply communicating geographical locations. Additionally, the development of state cartography was used for a number of administrative purposes, including the compilation and management of new discoveries, production and promotion of territoriality, and warfare.

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[130] Harley, J. B. et al.: 'Concluding Remarks', in The History of Cartography, ed. by J. B. Harley and David Woodward, 3 vols. (Chicago: UCP, 1987), vol. 1, pp. 502-509. p. 504.

Cartography for the State

There is a sizable amount of evidence that governments developed a determined interest in cartography in the late medieval and early modern period. In a survey of regional mapping, Paul Harvey noted that fifteenth-century Venice had placed a particularly high value upon cartography for administrative purposes.[131] Campbell noted the same might have been true for Genoa, given that the council granted Agostino Noli's petition for a cancellation of tax-debt, provided he train his brother as an apprentice chart-maker.[132] Certainly the Genoese administration must have had a keen interest in portolan cartography in the sixteenth century to annually pay Vesconte Maggiolo 100 *lire* to produce charts, a stipend which his family enjoyed from 1519 until 1649.[133]

Several early-modern states developed a great interest in cartography; in 1503, Queen Isabella I of Castile founded the *Casa de Contratación* in Seville, and from as early as 1415, various '*casas*' had been founded in Portugal which were amalgamated into the *Casa da Guiné, Mina e Índias* in the early sixteenth century, located in Lisbon, of which the *Armazém* (literally meaning 'depository') dealt with cartography.[134] These government institutions were responsible for the administration of overseas trade and governance and the management of state cartography; each appointed a state cartographer, who managed the mapping of incoming cartographic information onto the 'master map', known as the *Padrón Real* in Spain and the *Carta Padrão de el-Rei* in Portugal. In the late sixteenth century, the Dutch East India Company began employing state cartographers, which included Cornelis Claesz, Hessel Gerritsz, and Willem Janszoon Blaeu.[135] In 1548, Venice established the position of *Cosmografo della Repubblica*, the first holder of which was the cartographer Giacomo Gastaldi, who was responsible not only for producing maps, but for

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[131] Harvey, P. D. A.: 'Local and Regional Cartography in Medieval Europe', in *The History of Cartography*, ed. by J. B. Harley and David Woodward, 3 vols. (Chicago: UCP, 1987), vol. 1, pp. 464-501. p. 480.

[132] Campbell: (1987), pp. 430, 438.

[133] Astengo: (2007), pp. 209-212.

[134] Sandman, Alison: 'Spanish Nautical Cartography in the Renaissance', in *The History of Cartography*, ed. by David Woodward, 3 vols. (Chicago: UCP, 2007), vol. 3, pp. 1095-1142. p. 1096; Alegria, Maria Fernanda et al.: 'Portuguese Cartography in the Renaissance', in *The History of Cartography*, ed. by David Woodward, 3 vols. (Chicago: UCP, 2007), vol. 3, pp. 975-1068. p. 1003.

[135] Kagan, Richard L. et al.: 'Maps and the Early Modern State: Official Cartography', in *The History of Cartography*, ed. by David Woodward, 3 vols. (Chicago: UCP, 2007), vol. 3, pp. 661-679. p. 666.

instructing members of the Senate in cosmography and cartography.[136] Henri II of France established the position of *Géographe du Roi* in the mid-sixteenth century, and Kagan noted the existence of several German court cosmographers.[137] Sweden and Poland followed suit in the seventeenth century, and England, through pressure Lord Burghley put upon Elizabeth I to obtain improved maps for administrative purposes began employing cartographers – Christopher Saxton amongst them – to survey England and Wales, though the official position of 'Geographer Royal' was not established until 1671 under Charles II.[138]

The purpose of state cartography was not only to produce maps for official administrative use, but also to manage and control incoming cartographic information during the Age of Discovery. Amerigo Vespucci, the first *Piloto Mayor* of the *Casa de Contratación*, was tasked with the creation of a master chart – the *Padrón Real* – due to contradictions amongst existing charts.[139] Furthermore, this pattern chart was to be kept updated: "we order all the pilots of our realms… that finding new lands or islands or bays or new ports or any other thing which is fit to be put in the said pattern chart, that on returning to Castile they go to give their report to you, the said our pilot major, and to the officials of the House of Trade of Seville, so that everything be put in its place in the said pattern chart."[140] The master maps were kept updated but also largely secret from other states, and only partial copies were made and given to explorers prior to beginning their journeys.[141]

State cartography was also used for the production and promotion of territoriality and imperial rhetoric. The theory of the rhetorical power of maps has been discussed by a number of scholars, most notably J. B. Harley who wrote: "there is nothing revolutionary in the idea that cartography is an art of persuasive communication… the steps in making a map – selection, omission, simplification, classification, the creation of hierarchies, and 'symbolization' – are all inherently rhetorical".[142] Kagan and Schmidt applied Harley's

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[136] Ibid.

[137] Ibid. pp. 666-667.

[138] Ibid. pp. 667-668.

[139] Sandman: (2007), pp. 1109-1110.

[140] Translation by: Rubio, José Pulido: *El piloto mayor de la Casa de la Contratación de Sevilla: Pilotos mayores, catedraticos de cosmografía y cosmógrafos* (Seville, 1950), p. 463. Cited in: Sandman: (2007), p. 1110.

[141] Alegria et al.: (2007), p. 1010.

[142] Harley: (1989), p. 11.

theory to their evaluation of the development of official state cartography, and cited a number of examples of persuasive cartographic rhetoric. One such example was the 1424 production of a map of Tenochtitlán in Nuremberg, which celebrated the victory of Charles V and Christianity over the Aztec pagans. On the map appeared a decapitated pagan idol replaced with a cross, and the inscription: "a commonwealth that was once powerful and a realm of the greatest glory… He [Charles V], is truly outstanding. The Old World and the New [now] belong to him, and another is laid open to his rule."[143]

No nautical map from the time expresses the idea of territoriality more than the 1502 Cantino planisphere,[144] which is generally thought to have been an illegal copy of the Portuguese *Padrão Real*, smuggled out of Portugal for the Duke of Ferrara.[145] The map was not only the first to show the Portuguese mapping of India, but also the demarcation line of the 1494 Treaty of Tordesillas, through which Pope Alexander VI ruled that the Portuguese were entitled to all territory east, and the Spanish all territory west, of a meridian measured 370 leagues west of the Cape Verde islands. The fact the demarkation was established before any of the New World had been mapped indicates that the Pope and the interested parties had already developed a strong sense of territoriality, which could be best substantiated through maps.[146] Furthermore, it has been argued that the line not only territorialised whatever land was found on either side, but also the oceans themselves.[147] However, Steinberg evaluated the exact wording of the Papal bulls, and concluded that the line did not in any way impose territory or sovereignty, but "allocated to the two states exclusive vectors of exploration" into which they were to explore and spread Christianity to the native inhabitants.[148]

Regardless of Pope Alexander VI's non-territorial intentions, the conception of a sovereign division of the world grew increasingly pervasive: in 1502, Vasco da Gama sailed

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143 Kagan et al.: (2007), pp. 670-671.

144 Modena: Biblioteca Estense Universitaria.

145 Bagrow, Leo: *History of Cartography*, trans. by D. L. Paisley, ed. by R. A. Skelton, 2nd edn. (London: C. A. Watts, 1964; repr. Chicago: Precedent, 1985). p. 113.

146 Kagan et al.: (2007), p. 663.

147 Authors who have supported this view include: Grotius, Hugo: *The Freedom of the Seas, or the Right Which Belongs to the Dutch to Take Part in the East Indian Trade*, trans. by Ralph Van Deman Magoffin (1608; New York: OUP, 1916); Fulton, Thomas W.: *The Sovereignty of the Sea* (Edinburgh: William Blackwood, 1911); Gold, Edgar: *Maritime Transport: The Evolution of International Marine Policy and Shipping Law* (Lexington: Lexington Books, 1981). Cited in: Steinberg, Philip E.: *The Social Construction of the Ocean* (Cambridge: CUP, 2001). p. 76.

148 Ibid. pp. 75-86, esp. 81.

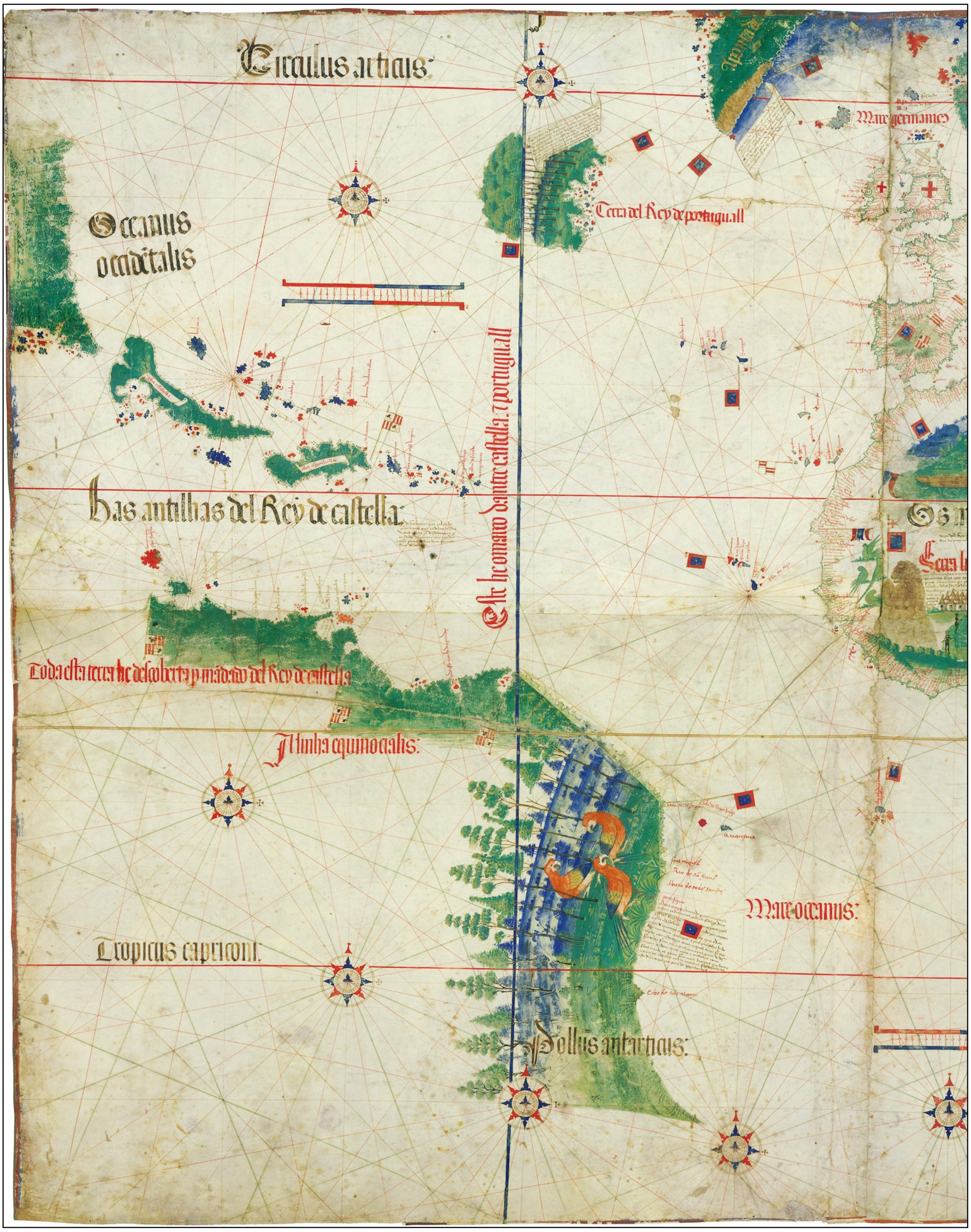

Figure 4.27: The western half of the Cantino Planisphere, depicting the prominently-drawn demarcation line from the 1494 Treaty of Tordesillas, accompanied by the text "Este he omarco dantre castella et portuguall" ("this is the boundary between Castile and Portugal"). Note that on the eastern side of the line there is the text "Terra del Rey de Portuguall" and a number of Portuguese flags, whereas on the western side there is the text "Las antillias del Rey de Castella", with several flags of Castile & Aragon. Image from Wikimedia Commons: <http://upload.wikimedia.org/wikipedia/commons/9/9c/Cantino_planisphere_%281502%29.jpg> [Accessed 10 October 2013].

into the Indian Ocean with a fleet of twenty warships, and proclaimed Portuguese suzerainty over the ocean, imposing several conditions upon Indian and Arab merchant vessels.[149] In 1518, Charles V approved a voyage by Ferdinand Magellan to cartographically prove that the Moluccas (known as the 'Spice Islands') were on the Spanish side of the antimeridian of the aforementioned Treaty of Tordesillas.[150] Magellan never returned from the journey, having perished in the Philippines in 1521, nor was Spain able to secure the Moluccas; a later effort to colonise the islands was defeated by the Portuguese, and in 1529, the Treaty of Saragossa was signed, demarcating the antimeridian, and establishing the Moluccas clearly in the Portuguese domain; Sandman noted that a map was drawn to establish the boundary but it has unfortunately not survived.[151]

Territoriality was not new to the sixteenth century however. As early as 1320, Petrus Vesconte (as discussed in Chapter II), used flags on his portolan maps to depict statehood and allegiance, likely in an effort to convince the rulers of Europe to engage in another crusade. Additionally, Albinus de Canepa used vexillography to indicate territories around the Black Sea which he, and/or for whomever the map was produced, considered to be Genoese, despite the territories having been conquered by the Ottoman Turks. Steinberg discussed the early development of

Figure 4.28: The western Mediterranean from the 1662 François Olive chart (Paris: BN, Ge SH Arch 43). Note how different colours of shading along the coastline were used to denote different regions, and sometimes different states. Image from: <http://gallica.bnf.fr/ark:/12148/btv1b59011662> [Accessed 7 February 2014].

[149] Nambiar, O. K.: *Our Seafaring in the Indian Ocean* (Bangalore: Jeevan, 1975). As cited in: Steinberg: (2001), p. 87.

[150] Sandman: (2007), p. 1111.

[151] Ibid. p. 1098.

territoriality on portolan charts and posited that they developed the cartographic 'grammar' that was later used to define sovereignty.[152] Colour was also occasionally used to define territory on the portolan charts; Petrus Roselli and Gratiosus Benincasa were the first to begin differentiating England and Scotland through a different-coloured coastline, and maps from the Oliva dynasty of cartographers in the sixteenth century often used colour to define individual coastal territories, an example of which is seen in figure 4.28.

Cartography for Professionals

There is evidence portolan maps were used for reference in a professional manner. Gautier Dalché proposed their usage for the drawing-up of merchant contracts by legal professionals, which would have required a knowledge of geography and the locations of ports, which was exactly the information portolan charts provided.[153] Pujades' compilation of documents identified five notaries that were owners of charts, and four jurists, yet he questioned Gautier Dalché's assessment, and argued that of the five notaries gleaned from his compilation of documents, only two might have used their maps in a professional context. He did admit however, that a chart would have been useful to a jurist dealing with maritime law.[154] Morse however noted the pivotal role of the notary in the management of the new territorial state in the sixteenth century.[155]

Although Pujades presented evidence that merchants might often have voyaged on board their own ships and carried their maps with them,[156] there is additionally the possibility that merchants used portolan charts as reference maps to plan and track current and future trade voyages. Astengo posited that wealthy merchants in the sixteenth and seventeenth centuries might have operated like Solanio in Shakespeare's *Merchant of Venice*, and no longer travelled with their vessels, but used maps to contemplate the expeditions.[157]

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[152] Steinberg, Philip E.: 'Insularity, sovereignty and statehood: The representation of islands on portolan charts and the construction of the territorial state', *Geografiska Annaler*, 87 B: 4 (2005), 253-265. p. 258.

[153] Gautier Dalché: (1996), pp. 109, 113-116.

[154] Pujades i Bataller: (2007), pp. 428-439, 452-453.

[155] Morse: (2007), p. 50.

[156] Pujades i Bataller: (2007), pp. 452-453.

[157] Solanio said in Act 1, Scene 1: "Believe me, sir, had I such venture forth / The better part of my affections would / Be with my hopes abroad. I should be still / Plucking the grass to know where sits the wind, / Peering in maps for ports and piers and roads." Astengo: (2007), p. 213 (note 230).

Madden discussed the Venetian *colleganza* system which developed in the eleventh century: in essence, one or more wealthy investors would fund a trade venture proposed by a merchant (who often was the owner of the ship), and the investor would have evaluated the proposed ports, the goods that would have been sold and bought in each location, and would have assessed the length and risks of the voyage.[158] Furthermore, in the fourteenth century, primitive insurance firms developed which would 'gamble' on the success of voyages, and although overall profits would have been lower, more investors might have been interested since the risk was lessened.[159] Indeed, in his *Libro dell'Arte di Mercatura*, Cotrugli wrote: "Et più li bisogna sapere le distantie, li siti, porti e piaggie, et molto bene la carta di navicare, per sapere noliggiare et assicurare".[160]

Although Madden made no mention of the use of maps in this context, it would be difficult to imagine that portolan charts would not have been used by Venetian merchants to visually illustrate their proposals, by investors and insurers to assess the risk of the ventures, and of course, by notaries who were required to draw up the contracts and keep detailed records. This assessment is confirmed by the patterns of ownership of portolan maps as discussed in the third chapter, which showed a large number of merchants, and a large number of the wealthy elite, who were potentially investors. Epstein discussed a similar system to *colleganza* that existed in Genoa in the late medieval and early modern period, and similar systems must have been common amongst maritime states.[161]

The evidence would suggest that an additional function of portolan cartography would have been as referential maps, used by state administrations and professionals who, for financial or political reasons, had a vested interest in seafaring, maritime trade, or the acquisition and consolidation of territory. Some maps, like the Cantino Planisphere, or Canepa's 1489 chart, were overtly rhetorical, whereas other maps were more mundane in their administrative function. An example is the 1567 Jacopo Maggiolo regional chart, which, as posited in Chapter II, might have been made for the Genoese council simply as a map of the locations of their local ports, with a greater number of Genoese toponyms that a standard portolan chart would display. Many of the portolan maps would have had a

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[158] Madden, Thomas F.: *Venice: A New History* (London: Viking Penguin, 2012). pp. 272-273.

[159] Ibid. p. 274.

[160] "… and they [merchants] need to know distances, sites, ports, and shores, and the charts very well, in order to charter and to insure [ships]". Cotrugli, Benedetto: *Il Libro dell'Arte di Mercatura*, ed. by Ugo Tucci (1468; repr. Venice: Arsenale, 1990). p. 213.

[161] Epstein, Steven A.: *Genoa & the Genoese* (Chapel Hill, NC: University of North Carolina Press, 1996). pp. 56-57.

multivalent function: expensive decorated maps, too valuable to use at sea and of which there were many, might have been used for the planning of voyages, or to assess the risk of proposed trade ventures, but could simultaneously have been educational, or to show off the erudition of the owner.

Spiritual and Scholarly Maps

It is likely that many portolan charts and atlases were owned by 'gentlemen scholars', and persons with a particular interest in cosmography and geography, which often was spiritual in nature, especially in the Middle Ages. Furthermore, although there is little direct evidence that portolan maps were used specifically as educational tools, there is some indication they could have been, and certainly maps in general were.[162] This section will briefly examine the portolan map as a instrument that embodied knowledge, whether cosmographical, geographical, or spiritual, and how it was used for scholarly purposes.

In the Middle Ages, geography and cosmography were a part of the same discipline, studied as part of the quadrivium; thus it is not surprising that early portolan charts incorporated cosmographical aspects onto their maps, most often borrowed from *mappaemundi*. The case studies of Chapter II discussed a number of examples of cosmographical inclusions, especially on the Dulceti and Roselli maps. Although no complete survey of the appearance of *mappamundi* symbology on portolan maps has been undertaken, a number of decorated charts depicted Noah's Ark on Mount Ararat, a cut-through across the Red Sea that symbolised the crossing made by the Israelites, Mount Sinai and the monastery of Saint Catherine, and pilgrimage sites like Santiago de Compostela and Jerusalem. Additionally, expository texts were found in abundance on numerous portolan maps, which were borrowed from *mappaemundi*. Angelino Dulceti and Giovanni da Carignano were the first map-makers to include texts in this manner, but they, and other incorporations from *mappaemundi*, became highly desirable additions for many luxury copies. Edson noted the c.1375 Catalan Atlas represented an "impressive attempt to integrate new cartographic knowledge with the old format."[163]

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[162] See: Cormack, Lesley B.: 'Maps as Educational Tools in the Renaissance', in *The History of Cartography*, ed. by David Woodward, 3 vols. (Chicago: UCP, 2007), vol. 3, pp. 622-636.

[163] Edson, Evelyn: *Mapping Time and Space: How Medieval Mapmakers Viewed Their World* (London: BL, 1997). p. 166.

Portolan maps not only borrowed directly from *mappaemundi*, but also synthesized spiritual and academic knowledge with newly discovered places. The early depictions of the Canaries, Azores and Madeiras were quite consistently labelled the '*Insule Sancti Brandani*', and when the islands of *Antillia* and *Salvaga* were 'discovered' in the early fifteenth century, chart-makers utilised the legend of the seven cities to add a historical context to the islands. Even into the sixteenth and seventeenth centuries, portolan maps often continued to include either the Madonna and child, or Christ crucified on the neck of the map, and depictions of religious events or locations continued to be popular additions, e.g. the holy temple of Jerusalem, or the hill of Calvary.

The discussion of ownership in Chapter III identified a number of religious figures who owned portolan maps, and indeed there were some who even produced them. Pujades' compilation of documents identified five clergymen. To this can be added a further four examples dating from 1300 to 1500: the Papal nuncio Prospero Camulius de Medici, for whom the 1468 Benincasa atlas was made; Pope Nicholas V, who likely owned the luxurious 1455 Pareto chart; Cardinal Riario, who owned a 1482 Benincasa atlas; and Pope John XXII, the beneficiary of Petrus Vesconte's maps included in Sanudo's *Liber secretorum*. A number of clerical owners were also identified from the sixteenth century by Astengo.[164] Furthermore, a few chart-makers were themselves members of the clergy, including Giovanni da Carignano, Opicinus di Canistris, and Bartolomeo Pareto.

It is unlikely that the portolan maps produced by and for the clergy were destined to be used for navigation, so other functions must be evaluated. Certainly the maps may have been used referentially, simply to be able to know the location of certain places, i.e. where the Hebrews crossed the Red Sea, or where Mount Ararat was, but it was also possible they had a spiritual or scholarly function. Some portolan maps were used for contemplation of the known world and its place within the cosmos. The Pavian mystic Opicinus de Canistris, who worked as a *scriptor* for the Avignon Papacy (c.1329 - c.1350), produced several diagrams which utilised the hydrography and rhumb line network from portolan charts to illustrate his cosmological ideas.[165] It has been suggested that the mid-thirteenth century itinerary maps by Matthew Paris may have been used for imaginary pilgrimages to the

[164] Astengo: (2007), pp. 178-180.

[165] Harding, Catherine: 'Opening to God: The Cosmographical Diagrams of Opicinus de Canistris', *Zeitschrift für Kunstgeschichte*, 61: 1 (1998), 18-39. p. 18.

Holy Land,[166] and it is a possibility that some portolan maps were used for the same purpose. Undoubtedly, the clergymen who owned the maps were equally well-educated scholars who would have retained a general interest in geography and even navigation.

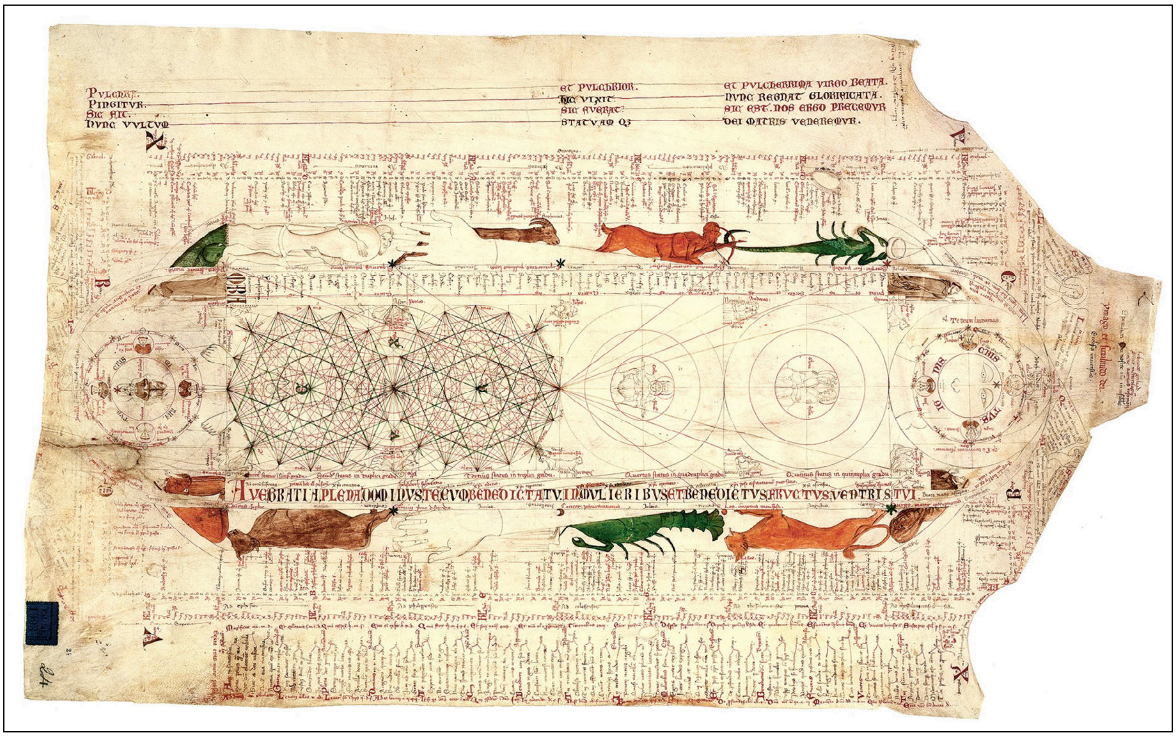

Figure 4.29: A zodiac diagram by Opicinus de Canistris, utilising a rhumb line network. Rome: BAV, Pal. Lat. 1993, f. 24r. Image courtesy of the Metropolitan Museum of Art: <http://blog.metmuseum.org/penandparchment/wp-content/uploads/2009/05/cat460r7_49f.jpg> [Accessed: 15 February 2014].

In the sixteenth century, the discipline of geography began to be distinguished from cosmography, and cartography was fully encompassed by the former rather than the latter. Lesley Cormack discussed the educational functions of cartography in the Renaissance, and cited numerous examples indicating maps were used for scholarly purposes.[167] For instance, the Spanish humanist Juan Luis Vives, in the employ of Catherine of Aragon, promoted the use of maps in grammar schools because they would incite curiosity within students.[168] Similarly, Cormack noted that the English humanist Thomas Blundeville believed cartography, cosmography, and navigational practices were essential for young gentlemen to learn.[169] The Savilian chairs of Astronomy and Geography, founded in 1619

166 Gaudio, Michael: 'Matthew Paris and the Cartography of the Margins', *Gesta*, 39: 1 (2000), 50-57.

167 Cormack: (2007).

168 Ibid. pp. 626-627.

169 Ibid. p. 627.

in Oxford, were required to teach geography and navigation.[170] In addition, Cormack noted Richard Pace's advocacy of the use of maps for teaching geography in his 1517 treatise *De Fructu Qui ex Doctrina Percipitur*: "But whoever takes the science of geography to heart either has to travel all over the world (which is extremely unpleasant, difficult, and expensive) or he has to read through Strabo, which is about as long and as broad as the earth and is a world in itself – and in Greek too, since the translation is extremely corrupt. But that's what you have to do, unless this seems shorter: to study the sketches of the globe called colloquially maps of the world [*mappaemundi*]."[171]

This function of being able to visually explore the world simply by looking at a map was also noted by the late-sixteenth-century Flemish cartographer Abraham Ortelius. In the preface to his seminal atlas *Theatrum Orbis Terrarum*, he wrote: "And when we haue acquainted our selues somewhat with the use of these Tables or Mappes, or haue attained thereby to some reasonable knowledge of Geography, whatsoeuer we shall read, these Chartes being placed, as it were certaine glasses before our eyes, will the longer be kept in memory, and make the deeper impression in us: by which meanes it commeth to passe, that now we do seeme to perceiue some fruit of that which we haue read."[172] According to Ortelius, not only could the geography of the world be encompassed and studied in a map, they could also be used as memory aides in the study of geography.

A number of scholars have suggested the ability of maps to act as mnemonic devices: for example, Veronica della Dora suggested that the repetitive use of an atlas by its user formed a conversation, through which the information contained within the atlas was memorised by the user.[173] Harley noted that "maps have often served as memory banks for spatial data and as mnemonics in societies without printing."[174] Tolias discussed how the mnemonics of maps changed in the Renaissance after the advent of printing and the

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[170] Ibid. p. 631.

[171] Pace, Richard: *De fructu qui ex doctrina percipitur (The Benefit of a Liberal Education)*, ed. and trans. Frank Manley and Richard S. Sylvester (New York: For the Renaissance Society of America by Frederick Ungar Publishing, 1967). p. 109. As cited in: Cormack: (2007), p. 626.

[172] Ortelius, Abraham: *Theatrum orbis terrarum… The Theatre of the Whole World* (London: Iohn Norton, 1606). As cited in: Tolias, George: 'Maps in Renaissance Libraries and Collections', in *The History of Cartography*, ed. by David Woodward, 3 vols. (Chicago: UCP, 2007), vol. 3, pp. 637-660. p. 642.

[173] della Dora, Veronica: 'Performative Atlases: Memory, Materiality, and (Co-)Authorship', *Cartographica*, 44: 4 (2009), 240-255. pp. 240-242.

[174] Harley, J. B.: 'The Map and the Development of the History of Cartography', in *The History of Cartography*, ed. by J. B. Harley and David Woodward, 3 vols. (Chicago: UCP, 1987), vol. 1, pp. 1-42. p. 1.

increased dissemination of cartography, concluding that maps played a vital role in the proliferation of early modern scholarly polymaths.[175] Campbell discussed the mnemonics of portolan charts specifically, and suggested that the unusual shape of some of the islands in the Aegean were never intended to be realistic depictions of their hydrography, but instead may have served to help the navigator recall his learned experience.[176]

The evidence would seem to indicate that some portolan maps had a spiritual function, whether it was simply to reference biblical places, or as aids to engage in imagined pilgrimages, or as reflections of God and the cosmos. Furthermore, although little of the evidence discussed above concerns portolan maps specifically, one can infer that nautical charts would have had some function in education. Astengo noted that a 1552 Batista Agnese atlas, which at one time belonged to the Archbishop of Mainz, was bought for the future Queen Christina of Sweden in 1637 by her geography tutor, which Astengo surmised was for the benefit of her education.[177] Certainly portolan maps were owned by gentlemen scholars; in Catherine Delano-Smith's examination of sixteenth-century Cambridge probate inventories, a number of academic owners were identified, several of whom owned nautical charts, including Edward Raven, a fellow of St John's College and Andrew Perne, the university vice-chancellor and master of Peterhouse.[178] Finally, maps seemed to have played a significant role as encyclopaedic devices used to explore the world, and as aids to retain geographic knowledge. Although more research is necessary, the evidence would suggest that in addition to a utilitarian referential and administrative function, some portolan maps had a spiritual and scholarly function as well.

Aesthetic Maps

A final alternative function for portolan maps would have been as aesthetic *objets d'art*. A number of scholars have examined the role that maps played in the early modern period as instruments of aesthetic pleasure. Tolias noted a passage written by John Dee in his 1570 translation of Euclid's *Elements* in which he listed the functions of cartography were

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175 Tolias: (2007), p. 639.

176 Campbell, Tony: 'Explanatory notes and wider implications of 'The colours and shapes used to denote some of the smaller islands and the major estuaries on portolan charts up to 1500'', (2011) <http://www.maphistory.info/PortolanColourNotes.html> [accessed 31 January 2013].

177 Astengo: (2007), pp. 181-182.

178 Delano-Smith, Catherine: 'Map Ownership in Sixteenth-Century Cambridge: The Evidence of Probate Inventories', *Imago Mundi*, 47 (1995), 67-93. pp. 83-90.

(paraphrased): first, aesthetic or encyclopaedic instruments; second, aids for locating places from history; third, to depict, evaluate (and perhaps moralise) political boundaries; and finally, for practical navigation or to study the voyages of others.[179] In Paolo Cortesi's 1510 description of the ideal Cardinal's palace – *De Cardinalatu* – he wrote: "and likewise there is no less delight to the learned in a painted picture of the world or the depiction of its parts which have recently become known through the daring circumnavigation[s] accomplished by our people, such as the exploration[s] of Manuel King of the Portuguese around India".[180]

An integral part of the aesthetic of maps was not only for the delight of the particular user of the map, but sharing that delight with others, and in many ways the collecting and displaying of maps was used to promote one's erudition. Fiorani discussed the case of Cosimo I de Medici, who had a great fondness for cosmography and geography, and "wished to model his interests, patronage, and public persona after that of ancient and modern emperors".[181] Begun in 1563, Cosimo created the *Guardaroba Nuova* in the Palazzo Vecchio in Florence, which was a room for him to exhibit his treasures, and which was decorated with a number of maps.[182] Fiorani posited that Cosimo I cleverly used the maps not only for display, but as a heuristic system of organising the other precious artefacts contained in the room.[183] Cosimo's court cosmographer – Egnazio Danti – was chosen to paint the maps, and he completed thirty of them by 1575, including a number of nautical charts.[184] Similarly, Pope Gregory XIII commissioned the famous Gallery of Maps at the Vatican Palace, which was completed in 1581. Although the latter did not exhibit portolan maps, both examples demonstrate the growing popularity of displaying collections of cartography in the early modern period.

In her doctoral thesis, Genevieve Carlton evaluated the role of printed cartography in sixteenth-century Italy. She argued that many maps were not so much tools of imperialism, or navigation, but were purchased by people to 'show-off' their erudition and

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[179] Tolias: (2007), p. 638.

[180] Weil-Garris, Kathleen et al.: 'The Renaissance Cardinal's Ideal Palace: A Chapter from Cortesi's "De Cardinalatu"', *Memoirs of the American Academy in Rome*, 35: 1: Studies in Italian Art and Architecture 15th through 18th Centuries (1980), 45-123. p. 96. See also: Tolias: (2007), p. 639.

[181] Fiorani, Francesca: *The Marvel of Maps: Art, Cartography and Politics in Renaissance Italy* (New Haven: Yale University Press, 2005). pp. 33-43 esp. 43.

[182] Tolias: (2007), p. 648.

[183] Fiorani: (2005), pp. 67-93.

[184] Tolias: (2007), p. 648.

worldliness to others.[185] She discussed the burgeoning number of maps being produced, largely due to the advent of printing, from under a few thousand before 1500 to over a million by 1600, and through an analysis of inventories showed that many were inexpensive enough to be purchased by an emerging middle class.[186] Carlton's exploration of over 2,200 household inventories in Venice between 1497 and 1631 revealed a clear growth in the number of residences that owned maps.[187] Furthermore, she discussed the sixteenth- and early-seventeenth-century evidence concerning how a Venetian gentleman would decorate his home; according to an account by Federico da Porto, upon visiting the home of Marino Saundo (the younger, 1466-1536), da Porto was greatly impressed by the number of maps displayed in Sanudo's *portego* (central hall).[188] A 1619 advice manual by Giulio Mancini, who had served as physician to Pope Urban VIII, recommended displaying maps in the public areas of the home, where they will be viewed by guests, not just residents.[189]

Carlton's study did not focus on manuscript maps or maps from before 1500, and she accepted the commonly-held belief that portolan charts were designed for navigation and were too limited in their audience to be commonly displayed.[190] Certainly there were fewer portolan maps made in the sixteenth and seventeenth-centuries than there were printed maps. It cannot be ruled out however, that they were not a part of this aesthetic promotion of erudition. In her examination of the Venetian inventories, Carlton found a total of 933 maps, 32 of which were navigational charts.[191] Although this was a small percentage, it is not insignificant: portolan maps, as Chapter III discussed, were more expensive than printed maps, on account of being produced on parchment and drawn manuscript.

There were certainly not millions of portolan maps produced, but this is no reason to believe they were not a part of the same aesthetic pattern, and it could be argued that the

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185 Carlton, Genevieve: 'Worldly Consumers: The Demand for Maps in Renaissance Italy' (Doctoral Thesis, Northwestern University, 2011). She reiterated many of these points in: Carlton, Genevieve: 'Making an Impression: The Display of Maps in Sixteenth-Century Venetian Homes', *Imago Mundi*, 64: 1 (2012), 28-40.

186 ---: (2011), pp. 16-18.

187 Ibid. pp. 192-193.

188 Ibid. pp. 225-226.

189 Ibid. pp. 237-238.

190 Ibid. pp. 57-58.

191 Ibid. p. 194 An attempt was made to contact Dr Carlton to explore the possibility of examining her notes for more information on the nautical charts to which her Venetian inventory analysis referred, but there has unfortunately been no response.

use of maps to promote one's erudition and worldliness could be brought further back into the fifteenth and fourteenth centuries, albeit on a smaller scale. The Majorcan merchant Nicolau de Quint, for example, kept a nautical chart described as "molt bela" in his study, in contrast to a smaller more utilitarian one described as small and torn in his kitchen.[192] It was surmised that the 1320 Petrus Vesconte atlas discussed in Chapter II was missing from the quire its central bifolium, which depicted the central Mediterranean, and had possibly been taken out of the atlas for display as an individual map.

Conclusion

The first part of this chapter examined the utilitarian aspects of portolan maps – their toponymy and their hydrography – in an attempt to determine how useful they could have been for navigation in the Mediterranean and the wider world. Having reached the conclusion that their navigational utility is questionable, this second part of the chapter explored the alternative functions of the maps. Portolan charts and atlases could have embodied several other functions: there is evidence that they were used to compile discoveries, to document territory and promote territorial ambitions, for administrative purposes, for educational purposes, spiritual mapping and contemplation, scholarly pursuits, and as aesthetic maps used to show off one's erudition.

A single map could embrace a number of these alternative functions simultaneously. The 1468 Benincasa atlas for example, not only included an extra page to document new discoveries the Portuguese had made less than a decade earlier, but the purchaser – Papal clerk Camulius de Medici – clearly wished to honor his city of Genoa with a large illustration (which had not been planned into the original layout of the map). From the addition of the large illustration and flag, it can be surmised that the atlas was not going to be used for personal study only, but would have been seen by others. Thus, it is possible Camulius was exhibiting his own worldliness by purchasing a map which included the most recent discoveries and his own pride in his home, and took the map with him when he became nuncio of the British Isles in the early 1470s.[193]

Undoubtedly, more research into the alternative functions of portolan maps would prove fruitful: analysis of inventories from archives would be wise to not only note if a

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[192] Pujades i Bataller: (2007), pp. 437, 456.

[193] See the case study of the 1468 Benincasa Atlas in Chapter II.

nautical map was present, but specifics about it, such as its value, condition, extent of decoration, and where it was kept in the property, if such information was recorded. As more archives are examined for this invaluable contextual evidence, the functions of these maps will become more clear. Furthermore, in-depth analysis of individual surviving maps and their makers will reveal the purposes of specific maps, from which a general paradigm may be surmised. These nautical maps remain enigmatic: although there is some documentary evidence which suggests their use for navigation, analysis of their practicalities has brought their actual utility into doubt. While perhaps some portolan maps were used for navigation, this could not have been their primary *raison d'être*. Instead, they embodied a variety of alternative functions: encyclopaedic, administrative, rhetorical, spiritual, scholarly, and aesthetic, and often times a combination of several of these at once.

Conclusion

The development of several maritime city-states and kingdoms between the eleventh and thirteenth centuries gave birth to a new form of cartography, the portolan chart. Unlike earlier *mappaemundi*, portolan cartography was based on a more scientific spatial mapping of distances and directions, which resulted in maps of the Mediterranean, Black Sea and Atlantic coastlines in a more geographically-recognisable form. Portolan charts and atlases were produced, in largely the same manner, from the thirteenth through the seventeenth centuries, until they grew out of fashion, and were gradually replaced by printed maps, and nautical charts based on measured latitude and longitude.

While there are over 1,800 extant portolan maps, many of which have been studied, this cartographic genre remains enigmatic.[1] Among the more fundamental questions regarding portolan maps concerns their function, which Tony Campbell noted "is arguably the most crucial [question] of all."[2] A number of scholars assumed their purpose was for navigation, including Nordenskiöld, Beazley, Oldham, and Winter.[3] Both Caraci and Campbell posited that the genre of portolan maps could be better assessed through division into utilitarian charts and other aesthetic or administrative maps.[4] The matter of function was most thoroughly assessed in Pujades i Bataller's 2007 book, *Les Cartes Portolanes*, in which he concluded that portolan maps were necessary for navigation, and thousands of utilitarian charts were made, of which few, if any, survive.[5]

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[1] Pflederer determined there are at least 1,842 extant charts and atlases dating from c.1290 through the end of the seventeenth century: Pflederer, Richard: *Census of Portolan Charts and Atlases* (Williamsburg: privately printed, 2009).

[2] Campbell, Tony: 'Portolan Charts from the Late Thirteenth Century to 1500', in The History of Cartography, ed. by J. B. Harley and David Woodward, 3 vols. (Chicago: UCP, 1987), vol. 1, pp. 371-463. p. 438.

[3] Nordenskiöld, A. E.: *Periplus: An Essay on the Early History of Charts and Sailing-Directions*, trans. by Francis A. Bather (Stockholm: P.A. Norstedt, 1897; repr. New York: Burt Franklin, 1964). p. 16; Beazley, C. Raymond: 'The First True Maps', *Nature*, 71 (1904), 159-161. pp. 159-161; Oldham, R. D.: 'The Portolan Maps of the Rhône Delta: A Contribution the History of the Sea Charts of the Middle Ages', *The Geographical Journal*, 65: 5 (1925), 403-424. pp. 404-405; Winter, Heinrich: 'The True Position of Hermann Wagner in the Controversy of the Compass Chart', *Imago Mundi*, 5 (1948), 21-26.

[4] Campbell: (1987), pp. 438-445 (esp. 440, & note 489).

[5] Pujades i Bataller, Ramón J. : *Les cartes portolanes: La representació medieval d'una mar solcada*, trans. by Richard Rees (Barcelona: Institut Cartogràfic de Catalunya, Institut d'Estudis Catalans, Institut Europeu de la Mediterrània, 2007). p. 521.

Conversely, two scholars have critically questioned the 'utilitarian hypothesis'. Falchetta queried why several earlier navigational manuals did not note the use of charts at sea, and he posited that their lack of precision might have made them unhelpful to navigators, who would have instead relied on their own experience.[6] Gautier Dalché highlighted a number of problems with the navigational utility of portolan maps, including their small scale and crude hydrographic generalisation, and questioned the ability of navigators to use the maps to calculate their position at sea.[7] The intention of this thesis was to evaluate the functions of portolan charts, and the evidence suggests that portolan maps were not navigational. This was accomplished through an original archaeological reconstruction of a portolan chart, an investigation of seven case studies of portolan maps and their makers, an evaluation of the contemporary archival and literary evidence, and an assessment of the practical utility of these charts, as indicated by how they were thought to be used at sea.

The first chapter discussed the production of portolan maps, through theories and documentary evidence concerning how they were made, compared with an experimental reconstruction of a chart to test the theory in practice. The evidence suggests there were four methods by which a chart could be copied. According to Martín Cortés, charts were produced either by the '*trasflorar*' process, in which an exemplar was traced onto transparent paper, then transferred onto parchment using carbon-transfer paper, or by using a square grid to aid in freehand copying, which could have been used to enlarge or reduce the scale.[8] Although the latter process has been questioned due to a lack of evidence of grids on extant charts, Cortés actually intended the grid process to involve the use of tracing and transferring as well. Bartolomeo Crescentio discussed two alternative processes: the first involved the puncture of the exemplar with needles, laying it over the copy, forcing 'pounce' through the holes, and tracing over the dots; the second involved placing the exemplar and the copy into an upright frame, and directly tracing the map, backlit with

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[6] Falchetta, Piero: 'The Use of Portolan Charts in European Navigation During the Middle Ages', in *Europa im Weltbild des Mittelalters: Kartographische Konzepte*: Nuremburg, 15-17 June 2006, ed. by Ingrid Baumgärtner and Hartmut Kugler. (Berlin: Akademie Verlag, 2008), pp. 269-276.

[7] Gautier Dalché, Patrick: 'L'usage des cartes marines aux XIV^{e} e XV^{e} siècles', in *Spazi, tempi, misure e percorsi nell'Europa del Basso medioevo. Atti del Convegno Storico Internazionale*: Todi, 8 - 11 October, 1995. (Spoleto: Centro italiano di studi sull'alto medioevo, 1996), pp. 97-128. pp. 13-14, 25-29.

[8] Cortés, Martín de Albacar: *Breve Compendio de la Esfera y del Arte de Navigar* (Seville, 1551). <http://documentomovil.usal.es/visor.php?f=nautica_bg_CortesAlbacar&v=dicter&p=1> [accessed 22 January 2013], pp. 128-135 (ff. 63r-66v).

daylight.[9] The experimental reconstruction of a portion of the 1403 Franciscus Becharius chart tested the '*trasflorar*' process, and determined that it was successful and entirely possible to have been used in the late Middle Ages. The reconstruction also determined that contrary to Pujades' doubts,[10] Crescentio's frame, which would have allowed direct tracing, was not only possible, but would have been the fastest method of production.[11]

The aim of this chapter was not only to investigate the methods of manufacture, but to assess how quickly a chart could be produced. If portolan charts were necessary and made in the thousands, they should have been able to be quickly replicated. However, the reconstruction experiment indicated that the making of a portolan map was a time-consuming process. The construction of a basic map of the Mediterranean would have taken two weeks, and decorated maps would have taken months to produce. Furthermore, there is little evidence to suggest that large ateliers existed: many chart-makers struggled to earn a living, and chart-making often appeared to have been a part-time or retirement activity, or involve small master-apprentice workshops. The first chapter indicated that Pujades' assertion that there existed "a system of almost mass production" of nautical maps is unfounded.[12]

The second chapter employed the analysis of seven case studies of maps and atlases, and discussed the cartographic output of their makers. The intent was to assess the specific functions of each map and understand their place within the genre. The first case study was the 1320 atlas of Petrus Vesconte,[13] which was once a part of Marino Sanudo's *Liber secretorum fidelium crucis*, a treatise designed to instigate a crusade following the fall of Acre in 1291. In addition to a *mappamundi,* grid map of the Holy Land, and city maps of Jerusalem and Acre, the atlas was possibly one of two gifted to Pope John XXII in 1321, and it was demonstrated that the central bifolium, which included a portolan map of the central Mediterranean, had been removed from the quire, possibly for individual display. Maps were included in the *Liber* not only to be visual aides to accompany the text, but also to

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[9] Crescentio, Bartolomeo: *Navtica Mediterranea* (Rome: Bartolomeo Bonfadino, 1602). <http://gallica.bnf.fr/ark:/12148/bpt6k51038x/f2.image.r=nautica%20mediterranea.langEN> [accessed 24 January 2013], pp. 189-190.

[10] Pujades i Bataller: (2007), p. 479.

[11] Future experimentation of all four methods will more thoroughly demonstrate the feasibility of each process and the time each would take.

[12] See: Ibid. p. 478, and Pujades i Bataller, Ramón J.: *La Carta de Gabriel de Valseca de 1439*, trans. by Catalina Gironda Arguimbau (Barcelona: Lumen Artis Ediciones, 2009). p. 328.

[13] Rome: BAV, Pal. Lat 1362A.

demonstrate Sanudo's passion and erudition. Furthermore, the atlas was the first to include vexillography, possibly at the behest of Sanudo, which was used to inspire and persuade the nobles of Europe to follow Sanudo's plan to retake the Holy Land. The *Liber* was thoroughly disseminated across Europe, and although not all copies included portolan maps, it is possible that Sanudo was responsible for popularising what had been a relatively obscure cartographic genre amongst the wealthy elite.

The second case study was the 1339 chart of Angelino Dulceti, produced in Majorca.[14] The chart included a large number of well-planned historical, anthropological, geopolitical, and spiritual motifs in the form of texts and illustrations. Given the number and range of these additions, the map would have taken months to produce, and had an encyclopaedic and scholarly function. Moreover, they demonstrated that Dulceti not only was a skilled cartographer, but was highly knowledgeable about the world. Much of the style and content, which originated with Dulceti, was copied for over a century on maps by a number of cartographers, not all of whom were Majorcan.

The 1403 chart of Franciscus Becharius, made in Savona, was the subject of the third case study.[15] As his only extant map, its survival is fortunate because of Becharius' historically-invaluable 'Address to the Reader'.[16] This text indicated that chart-makers acquired new information through word-of-mouth, and Becharius, having listened to seafarers, altered the hydrography of the Atlantic northwards, and shifted the position of Sardinia. The text demonstrated the conservatism of chart-makers, and although it has been championed by those who support the 'utilitarian hypothesis', the study demonstrated that it does not prove maps were used regularly at sea. Instead, the text suggests that most chart-makers, Becharius excepted, were unconcerned about making corrections to their maps. Furthermore, the fact that Becharius made corrections does not necessarily indicate he made maps for navigation: instead, Becharius may have been promoting their sale, like later printed maps that included in their titles 'an updated' or 'a new and perfect' to self-advertise. The carefully chosen decoration of Franciscus' chart indicates it was not a map used at sea, and was rather an exemplar from which other maps would be copied.

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[14] Paris: BN, Rés. Ge. B 696.

[15] New Haven: BRBML, Art Storage 1980.158.

[16] The text was transcribed in: Kraus, H.P.: *Twenty-Five Manuscripts* (Vaduz, Liechtenstein: Rare Books, 1961). pp. 63-64, and reproduced in the case study.

The fourth case study examined the 1465 map of the prolific Majorcan chart-maker Petrus Roselli.[17] Although the map itself is in poor condition, and trimmed from its original size, it was sumptuously decorated, would have taken months to produce, and must have been quite expensive. Hydrographic analysis found that Roselli adopted many of the changes made by Franciscus Becharius. Examination of the decoration, which included internal geography, flags, cities, monarchs, and texts, demonstrated that he had uncritically copied many motifs introduced by Angelino Dulceti and propagated through Gabriel de Valseca, without concern to update obsolete information.

The 1468 atlas of Gratiosus Benincasa was examined as the fifth case study.[18] From the number of extant maps, Gratiosus was the most prolific chart and atlas-maker in the fifteenth century. The analysis of the atlas demonstrated that it was an off-the-shelf atlas purchased by Prospero Camulius de Medici, who was a Papal nuncio for the British Isles from 1474, and later Bishop elect of Caithness. Gratiosus did not generally decorate his maps extensively, but the large illustration of Genoa, painted above nearby toponyms suggested it was an unplanned decoration, probably requested by Camulius. The atlas additionally included a map of the Atlantic African coastline beyond Cape Bojador, as far as the Cape Verde islands, which had only been explored by the Portuguese six years earlier. This indicates that Benincasa had direct or indirect access to unknown Portuguese maps. Nevertheless, it is improbable Camulius used the atlas for navigation; more likely, it was for his personal scholarship, and potentially for display to his educated guests.

The sixth case study was the 1489 Albinus de Canepa chart, made in Genoa.[19] Little is known about Canepa, but hydrographic and stylistic examination indicated a strong possibility that he apprenticed under Petrus Roselli, or at least used a Roselli map as his exemplar. The chart was more skillfully-made in its artistry than its hydrography, and included a large number of decorations, including cities, stylised mountains, compass roses, and most notably several flags. Canepa placed twelve large Genoese flags around port cities on the Black Sea, which had been conquered by the Ottomans between 1453 and 1475. The patriotism of Canepa (or his patron) must be viewed through the context of the decline of the Republic, which in recent memory had lost the last vestiges of empire, and had become a political pawn between France, Milan and Aragon. Like Vesconte's *Liber*

[17] London: BL, Eg. 2712.

[18] London: BL, Add. MS. 6390.

[19] Minneapolis: JFBL, B1489mCa.

maps, the numerous flags were possibly included to promote Genoese identity following a crisis, and perhaps even to encourage a crusade to retake Caffa.[20]

The final case study examined the 1567 chart by Jacopo Maggiolo.[21] The map was unusual for the genre, drawn at a much larger scale, and only encompassed the Ligurian, Tuscan, and Laziale coastlines, Corsica and Sardinia. Although Astengo theorised that the map was made for navigation,[22] analysis of the hydrography demonstrated that it was not more accurate than a regularly-sized portolan map. Analysis of the toponymy suggested that the map was made to catalogue Genoese places around Corsica and the Liguran coast, but the large number of mistakes ruled out the possibility that the map was constructed from another of the same size. This indicates that large-scaled regional maps were rare, not commonplace. Thus, Jacopo's chart was not representative of navigational maps, but was instead an atypical compilation, probably made for the Genoese administration or the Bank of Saint George. Overall, the second chapter demonstrated that many portolan chart-makers made copies of earlier maps, duplicating their toponymy, hydrography, and stylistic content, often without concern for making updates or corrections.

The third chapter explored the contemporaneous archival and literary evidence to investigate the market for portolan maps. A number of literary sources noted the use of maps at sea, though they were often fanciful and unspecific with details. Only one technical manual prior to the sixteenth century – the *De Navigatione* by Benedetto Cotrugli – discussed the use of charts for navigation, yet it was unpublished, and curiously many other manuals did not mention maps. However, a number of sixteenth-century manuals did note the use of charts at sea, but it is questionable whether these texts, produced for scholars, actually described a commonplace process, or prescribed a theoretical one.

Pujades presented a number of archival documents from which a pattern of ownership was gleaned for the fourteenth and fifteenth centuries.[23] Only two-fifths of the identified owners were seafarers, while the rest were merchants, nobles, clergy, and a few professional landsmen. Although Pujades concluded that this pattern of ownership indicated the maps were used for navigation, the fact that the maps were owned by people

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[20] The Genoese plan to retake Caffa was discussed in: Epstein, Steven A.: *Genoa & the Genoese* (Chapel Hill, NC: University of North Carolina Press, 1996). p. 290.

[21] Rome: BNC, Carte nautiche, 5.

[22] Astengo, Corradino: 'Una Carta de Navigare del 1567', *Itineraria: Letteratura di viaggio e conoscenza del mondo dall'Antichità al Rinascimento*, 2 (2003), 289-303. p. 296.

[23] Pujades i Bataller: (2007), pp. 428-447.

with an interest in the sea, does not prove a navigational utility. Future archival research is needed to establish a clear pattern of ownership for the sixteenth and seventeenth centuries, but it would seem that the ownership of maps became more concentrated towards wealthy erudite men. Price was also discussed, and the evidence suggested that while undecorated maps were affordable, decorated maps were costly. Synthesis of the price analysis and the methods of production in Chapter I indicate that decorative maps would have been more profitable. The evidence that there were not many chart-makers in operation at any given time, and the questionable existence of large workshops, indicates that there was not a large demand for portolan maps, otherwise the price would have been higher or there would have been more map-makers. Although there is some documentary evidence of the use of charts at sea, the evidence suggests the primary market for maps was for decorative ones, which were most likely not used at sea.

It is not difficult to understand how, upon examination of much of the documentary evidence, one could reach the conclusion portolan maps were used at sea. However, the analysis of their actual utility in the first part of Chapter IV demonstrates they could not have been functional for navigation. It is highly unlikely that two distinct exemplars existed for the manufacture of portolan maps: one accurate and another inaccurate. Instead, as the first and second chapters indicated, all maps used the same hydrography, copied from one to another.[24] Analysis of the evolution of toponymy and hydrography in the fourth chapter indicated an additive but not corrective paradigm. Chart-makers were generally quick to incorporate new discoveries, but were generally slow to alter what was already mapped, which was a result of the copying process: changes were time-consuming and thus expensive to make. A future cartometric study of hundreds of maps would be able to show the exact evolution of their hydrography, and likewise a substantial toponymic study would show their progression.

There were three substantial problems with the utility of the portolan map. First, using the cartometric data provided by Pujades,[25] various calculations were made, which indicated that the scale used on portolan maps was variable by a considerable percentage, not only between maps, but internally within the same maps. Without a consistently-sized

[24] Also, as Pelham suggested, the hyperbolic hydrography was a result of the copying process, not an effort to make the maps more accurate or useful for navigators. See: Pelham, Peter Thomas: 'The Portolan Charts: Their construction and use in the light of contemporary techniques of marine survey and navigation' (Unpublished MA Thesis, Victoria University, 1980). pp. 90-91.

[25] Pujades i Bataller: (2007), pp. 204-209. His measurements and my calculations are presented in Appendix I of this thesis.

portolan *miglia*, it is questionable how a navigator could have estimated the distance he had sailed, which was vital to the process of 'taking point'. Second, the small scale of portolan charts would have made them nearly impossible to use. Cotrugli recommended 'taking point' on an hourly basis, yet in the thirteenth and fourteenth centuries, ships would not have been able to sail faster than about three knots, which on the average-scaled portolan map would have equated to less than a millimetre each hour. The system Cotrugli proposed would have been impossible to measure hourly, and quite difficult even on a daily basis, especially as shifting winds would have required navigators to change course frequently. This problem discredits Cotrugli's process, making it considerably more likely that the method of 'taking point' was largely theoretical, and not a description of what pilots actually did. Third, analysis of the angular skew of portolan charts, resulting from magnetic deviation, indicated that no effort was made to correct portolan maps as the position of the magnetic pole changed over time, until the late sixteenth century. This too would have also made it highly difficult for navigators to estimate their position on a map, because the angle measured might have been off by as much as ten degrees.

These three major problems indicate that portolan maps would not have been useful for navigation. Instead, portolan maps existed for a number of other functions, which were discussed in the second part of Chapter IV. Portolan maps were used to record and compile new discoveries, and state cartography grew in importance in the sixteenth century to establish territories and sovereignty. There is a strong indication that portolan maps were used by merchants and investors to plan voyages, seek investment and assess risk for insurance purposes. Portolan maps were certainly used for spiritual and scholarly purposes, given the historical, anthropological, and religious content apparent on many of them. Finally, portolan maps were likely used by wealthy people to demonstrate their worldliness, in a similar way to printed maps in the sixteenth century.[26] The evaluation of the evidence does not support the theory that portolan maps were used for navigation. Instead, they embodied several other functions, often simultaneously.

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26 See: Carlton, Genevieve: 'Worldly Consumers: The Demand for Maps in Renaissance Italy' (Doctoral Thesis, Northwestern University, 2011).

Appendix I: Scale Calculations of the 'Miglia' (Charts)[1]

	Date	Author / Name	Reference	Base Length of 50 *'miglia'* (in cm)	Measured distance of Barcelona - Marseilles (339km) (in cm)	Calculated length of 1 *'miglia'* (in km)	Measured distance of Capo Spartivento - Tripoli (608km) (in cm)	Calculated length of 1 *'miglia'* (in km)	Measured Distance of Cabo de San Antonio - Beirut (3190km)	Calculated length of 1 *'miglia'* (in km)	Measured distance of Constanța, Romania - Trabzon, Turkey (975km)	Calculated length of 1 *'miglia'* (in km)	Measured distance of Pointe Saint-Mathieu - Calais (560km)	Calculated length of 1 *'miglia'* (in km)
1	late 13th	'Carte Pisane' (anon.)	Paris: BNF, Rés. Ge. B1118	1.4	7.5	1.266	12.5	1.362	69.5	1.285	x		5.7	2.751
2	beginning 14th	Cortona Chart' (anon.)	Cortona: AE, port. 105	1	x		9.8	1.241	x		19.3	1.010	x	
3	1311	Vesconte, Petrus	Florence: AS, CN1	1	x		10.1	1.204	x		18.7	1.043	x	
4	1st quarter 14th	Anon. Genoese	Florence: BR, 3827	1.1	6.0	1.243	11.1	1.205	58.2	1.206	20.6	1.041	8.8	1.400
5	1327	Vesconte, Perrino	Florence: BML, Med. Pal. 248	1.1	6.2	1.203	11.4	1.173	58.3	1.204	21.9	0.979	9.1	1.354
6	c. 1327	Carignano, Giovanni da	Florence: AS, CN2 (destroyed)	1	5.2	1.304	10.2	1.192	53.7	1.188	19.4	1.005	7.6	1.474
7	1325-1330	Dalorto, Angelino de	Florence: col.1 Corsini	1.1	6.1	1.223	11.0	1.216	58.0	1.210	21.5	0.998	8.1	1.521
8	1339	Dulcert, Angelino	Paris: BNF, Rés. Ge. B696	1.1	6.1	1.223	10.9	1.227	56.1	1.251	21.0	1.021	8.0	1.540
9	1339-1350	Dulcert, Angelino (attr.)	London: BL, ms. add. 25691	1	5.6	1.211	9.6	1.267	53.0	1.204	19.6	0.995	7.1	1.577
10	2nd quarter 14th	Anon. Genoese	Sotheby's Catalogue: 15 April 1980, A	1.1	6.1	1.223	11.5	1.163	x		x		8.8	1.400
11	2nd quarter 14th	Anon. Genoese (same atelier as one below)	Washington: LC, Ristow-Skelton 3	1.1	x		11.3	1.184	x		x		x	
12	2nd quarter 14th	Anon. Genoese (same atelier as one above)	Paris: BNF, Rés. Ge. 1131	1.1	6.3	1.184	11.3	1.184	58.0	1.210	20.0	1.073	8.2	1.502
13	1367	Pizzigano, Domenico or Marco	Parma: BP, ms. Parm. 1612	1.1	6.3	1.184	12.6	1.062	61.8	1.136	22.7	0.945	8.7	1.416
14	1368-1385	Soler, Guilermo	Paris: BNF, Rés. Ge. B1131	1	x		9.7	1.254	52.2	1.222	19.1	1.021	7.0	1.600
15	3rd quarter 14th	Anon. Mallorcan (Cresques' atelier)	Venice: BNM, It.IV.1912 (010057)	1.1	6.5	1.147	11.7	1.143	63.5	1.105	24.4	0.879	x	
16	c. 1375	Cresques, Abraham (attr.) 'Catalan Atlas'	Paris: BNF, ms Espagnol 30	1	5.4	1.256	10.0	1.216	52.6	1.213	19.1	1.021	7.3	1.534
17	1385	Soler, Guilermo	Florence: AS, CN3	1	5.6	1.211	9.7	1.254	52.2	1.222	19.2	1.016	7.0	1.600
18	4th quarter 14th	Anon. Mallorcan (Cresques' atelier)	Florence: BNC, port. 22	1.1	6.4	1.165	11.5	1.163	x		x		9.0	1.369
19	4th quarter 14th	Anon. Mallorcan (Cresques' atelier)	Naples: BN, ms. XII, D102	1.1	6.4	1.165	11.8	1.134	64.1	1.095	24.0	0.894	8.7	1.416
20	4th quarter 14th	Anon. Venetian (Pizzigano family)	Venice: MC, port. 30	1	6.0	1.130	9.9	1.228	51.6	1.236	18.5	1.054	7.0	1.600
21	late 14th	Anon. Mallorcan (Cresques' atelier)	Paris: BNF, Rés. Ge. AA751	1	5.6	1.211	9.7	1.254	52.9	1.206	19.3	1.010	7.3	1.534
22	late 14th	Anon. Venetian (Pizzigano family?)	Cairo: col.1. Youssouf Kamal	1.1	x		11.1	1.205	x		21.0	1.021	x	
23	1403	Beccari, Francesco	New Haven: BRMBL, 1980.158	1.6	9.8	1.107	17.4	1.118	87.5	1.167	32.2	0.969	14.3	1.253
24	1409	Virga, Albertin de	Paris: BNF, Rés. Ge. D7900	0.9	4.7	1.298	8.3	1.319	44.3	1.296	12.3	1.427	6.1	1.652
25	beginning 15th	Anon. Venetian (poss. Virga, A de)	Venice: MC, port. 40	1.1	6.4	1.165	12.6	1.062	62.0	1.132	22.5	0.953	8.8	1.400
26	1413	Al-Kātibī al-Tunusi, Ibrahim	Istanbul: TSM, 49356/2753	1	5.1	1.329	10.2	1.192	50.7	1.258	17.6	1.108	6.7	1.672
27	1413	Viladestes, Mecia de	Paris: BNF, Rés. Ge. AA566	1	5.2	1.304	10.0	1.216	54.5	1.171	19.5	1.000	7.0	1.600
28	c. 1420	Anon. Venetian	Milan: BA, F 260 inf. 2	1	5.4	1.256	9.6	1.267	51.9	1.229	18.8	1.037	7.4	1.514
29	1421	Cesanis, Francesco	Venice: MC, port. 13	1.1	6.5	1.147	10.4	1.286	58.3	1.204	21.5	0.998	7.5	1.643
30	1422	Giroldi, Giacomo	Paris: BNF, Rés. Ge. C5088	1	6.1	1.111	10.4	1.169	54.0	1.181	19.7	0.990	7.1	1.577
31	1423	Viladestes, Mecia de	Florence: BML, ASHB 1802	1	5.2	1.304	9.4	1.294	52.0	1.227	18.9	1.032	6.7	1.672
32	1424	Pizzigano, Zuane (attr.)	Minneapolis: JFBL, 1424mPi	1	x		x		x		x		9.2	1.217
33	1426	Beccari, Battista	Munich: BayS, Cod. Icon. 130	1.2	6.5	1.252	11.0	1.327	x		x		10.1	1.331

[1] Information contained in all columns except those entitled "Calculated Length of 1 'miglia' (in km)" is found in: Pujades i Bataller: (2007), pp. 204-209. The calculations of averages and medians is original.

	Date	Author / Name	Reference	Base Length of 50 *'miglia'* (in cm)	Measured distance of Barcelona - Marseilles (339km) (in cm)	Calculated length of 1 *'miglia'* (in km)	Measured distance of Capo Spartivento - Tripoli (608km) (in cm)	Calculated length of 1 *'miglia'* (in km)	Measured Distance of Cabo de San Antonio - Beirut (3190km)	Calculated length of 1 *'miglia'* (in km)	Measured distance of Constanța, Romania - Trabzon, Turkey (975km)	Calculated length of 1 *'miglia'* (in km)	Measured distance of Pointe Saint-Mathieu - Calais (560km)	Calculated length of 1 *'miglia'* (in km)
34	1428	Viladestes, Johanes de	Istanbul: TSM, 1826	1	5.4	1.256	9.8	1.241	53.5	1.193	19.8	0.985	7.0	1.600
35	1435	Beccari, Battista	Parma: BP, ms. Parm. 1613	1.2	6.5	1.252	11.1	1.315	x		x		10.0	1.344
36	1439	Valseca, Gabriel de	Barcelona: MM, Inv. 3236	0.9	5.0	1.220	7.9	1.385	41.5	1.384	16.3	1.077	6.6	1.527
37	c. 1440	Anon. Mallorcan (Valseca's atelier)	Florence: BNC, port. 16	1	5.2	1.304	9.7	1.254	51.0	1.251	19.2	1.016	8.2	1.366
38	1447	Valseca, Gabriel de	Paris: BNF, Rés. Ge. C4607	1.1	6.6	1.130	11.1	1.205	63.8	1.100	24.0	0.894	x	
39	1447	Roselli, Petrus	Volterra: BG, ms. CN1	1.1	6.5	1.147	11.1	1.205	x		x		9.8	1.257
40	1447	Giroldi, Giacomo	New York: HS, K4	1	6.0	1.130	9.8	1.241	53.0	1.204	18.8	1.037	9.2	1.217
41	1448	Bianco, Andrea	Milan: BA, F 260 inf. 1	1	x		x		x		x		9.2	1.217
42	1449	Valseca, Gabriel de	Florence: AS, CN22	1.1	6.4	1.165	11.0	1.216	63.3	1.109	23.7	0.905	x	
43	1449	Roselli, Petrus	Karlsruhe, BLK, S6	1.1	6.4	1.165	11.1	1.205	62.5	1.123	23.5	0.913	x	
44	2nd quarter 15th	Anon. Venetian (same author as Atlas no. 26)	Florence: AS, CN11	1.1	x		10.4	1.286	x		20.3	1.057	x	
45	2nd quarter 15th	Anon. Italian	Barcelona: ACA, MP1	0.9	4.7	1.298	8.6	1.273	45.4	1.265	15.7	1.118	6.2	1.626
46	2nd quarter 15th	Anon. Mallorcan (poss. R. Soler's atelier)	Paris: BNF, Rés. Ge. B8268	1.1	6.5	1.147	10.5	1.274	61.5	1.141	21.4	1.002	8.0	1.540
47	2nd quarter 15th	Soler, Rafel	Berlin: GI-UH, H14-12	1.1	6.3	1.184	11.0	1.216	57.5	1.221	21.0	1.021	x	
48	2nd quarter 15th	Anon. Genoese (attr. B. Beccari)	Sidney R. Knafel collection	1.2	6.6	1.233	11.2	1.303	59.6	1.285	21.5	1.088	10.2	1.318
49	1st half 15th	Anon. Tunisian	Milan: BA, SP 2 259	0.7	3.2	1.483	x		x		x		4.2	1.867
50	1455	Pareto, Bartolomeo	Rome: BN, CN1	1.1	6.5	1.147	11.6	1.153	63.3	1.109	23.2	0.925	10.1	1.220
51	1456	Bertran, Jaime & Ripoll, Berenguer	Greenwich: NMM, G230:1/7	1	5.1	1.329	9.2	1.322	50.1	1.273	19.1	1.021	8.2	1.366
52	1456	Roselli, Petrus	Chicago: NL, ms. Ayer Coll. map 3	0.7	3.4	1.396	6.2	1.373	36.1	1.237	13.5	1.011	6.0	1.307
53	1461	Al-Mursī, Ibrāhīm	Istanbul: Deniz Mürzesi, 882	1.1	6.5	1.147	11.1	1.205	58.3	1.204	21.0	1.021	8.5	1.449
54	1461	Benincasa, Gratiosus	Florence: AS, CN5	0.9	4.3	1.419	7.8	1.403	41.7	1.377	16.5	1.064	7.3	1.381
55	c. 1461	Benincasa, Gratiosus	Florence: AS, CN6	1	5.2	1.304	9.1	1.336	52.3	1.220	19.5	1.000	8.9	1.258
56	1462	Roselli, Petrus	Paris: BNF, Rés. Ge. 5090	1	5.0	1.356	9.0	1.351	52.4	1.218	19.2	1.016	8.2	1.366
57	1464	Roselli, Petrus	Nuremberg: GN, La. 4017	1	5.0	1.356	9.1	1.336	50.0	1.276	18.8	1.037	8.2	1.366
58	1465	Roselli, Petrus	London: BL, ms. Egerton 2712	1	5.2	1.304	8.8	1.382	49.8	1.281	18.5	1.054	8.0	1.400
59	1466	Roselli, Petrus	Minneapolis: JFBL, s. s.	1	5.2	1.304	9.1	1.336	49.5	1.289	17.9	1.089	8.1	1.383
60	1468	Roselli, Petrus	New York: HS, K35	1	5.2	1.304	8.9	1.366	49.8	1.281	18.1	1.077	8.0	1.400
61	1468	Benincasa, Gratiosus	Mallorca: Fund. March-Servera	1.6	x		x		x		x		13.0	1.378
62	3rd quarter 15th	Anon. Mallorcan (Roselli's atelier)	Paris: BNF, Rés. Ge. C5096	1.1	6.6	1.130	11.0	1.216	x		x		9.8	1.257
63	mid. 15th	Anon. Mallorcan	New Haven: BRMBL, s. s.	1.4	7.5	1.266	13.4	1.270	71.4	1.251	26.0	1.050	x	
64	3rd quarter 15th	Anon. Mallorcan (Roselli's atelier)	Modena: BEU, C. G. A.5b	1.1	6.6	1.130	11.4	1.173	63.3	1.109	x		9.8	1.257
65	end 15th / beg. 16th	Anon. Venetian	New York: HS, K15	1.4	x		14.2	1.199	x		28.9	0.945	x	
66	3rd quarter 15th	Anon. Venetian (G. Benincasa's atelier)	Paris: BNF, Rés. Ge. D21815	1	5.0	1.356	x		x		x		x	
67	3rd quarter 15th	Anon. Venetian (G. Benincasa's atelier)	Venice: BC Bert. ms. 524	1	5.2	1.304	9.7	1.254	49.5	1.289	x		x	
68	2nd half 15th	Anon. Italian	Mallorca: ARM, s. s.	1	x		x		x		x		7.9	1.418

Date	Author / Name	Reference	Base Length of 50 *'miglia'* (in cm)	Measured distance of Barcelona - Marseilles (339km) (in cm)	Calculated length of 1 *'miglia'* (in km)	Measured distance of Capo Spartivento - Tripoli (608km) (in cm)	Calculated length of 1 *'miglia'* (in km)	Measured Distance of Cabo de San Antonio - Beirut (3190km)	Calculated length of 1 *'miglia'* (in km)	Measured distance of Constanța, Romania - Trabzon, Turkey (975km)	Calculated length of 1 *'miglia'* (in km)	Measured distance of Pointe Saint-Mathieu - Calais (560km)	Calculated length of 1 *'miglia'* (in km)
				AVERAGE:	1.237	AVERAGE:	1.243	AVERAGE:	1.215	AVERAGE:	1.019	AVERAGE:	1.467
	OVERALL CHART AVERAGE:	1.233										AVG. w/o Carte Pisane:	1.443
	OVERALL AVERAGE OF EVERYTHING:	1.241		MEDIAN:	1.223	MEDIAN:	1.235	MEDIAN:	1.215	MEDIAN:	1.018	MEDIAN:	1.408
				MINIMUM:	1.107	MINIMUM:	1.062	MINIMUM:	1.095	MINIMUM:	0.879	MINIMUM:	1.217
				MAXIMUM:	1.483	MAXIMUM:	1.403	MAXIMUM:	1.384	MAXIMUM:	1.427	MAXIMUM:	2.751
												MAX w/o Carte Pisane:	1.867
			OVERALL AVERAGES:		1.242		1.252		1.215		1.033		1.447

	Indicates the lowest value in a particular column
	Indicates the highest value in a particular column

Appendix I: Scale Calculations of the 'Miglia' (Atlases)

	Date	Author / Name	Reference	Base Length of 50 '*miglia*' (in cm) for adjacent column	Measured distance of Barcelona -Marseilles (339km) (in cm)	Calculated length of 1 '*miglia*' (in km)	Base Length of 50 '*miglia*' (in cm) for adjacent column	Measured distance of Capo Spartivento - Tripoli (608km) (in cm)	Calculated length of 1 '*miglia*' (in km)	Base Length of 50 '*miglia*' (in cm) for adjacent column	Measured distance of Constanța, Romania - Trabzon, Turkey (975km)	Calculated length of 1 '*miglia*' (in km)	Base Length of 50 '*miglia*' (in cm) for adjacent column	Measured distance of Pointe Saint-Mathieu, Brittany - Calais (560km)	Calculated length of 1 '*miglia*' (in km)
1	1313	Vesconte, Petrus	Paris: BNF, Rés. Ge. DD687	1.1	5.9	1.264	1.6	16.6	1.172	1.6	27.8	1.122	1.1	8.5	1.449
2	1318	Vesconte, Petrus	Venice: MC, port. 28	1.0	6.0	1.130	1.0	11.6	1.048	1.0	19.7	0.990	1.3	8.6	1.693
							0.7	7.4	1.150						
3	1318	Vesconte, Petrus	Vienna: ONB, ms. 594	1.1	x		0.7	7.5	1.135	0.7	13.6	1.004	1.3	8.6	1.693
4	1321/2	Vesconte, Petrus	Vatican: BAV, ms. Pal. Lat. 1362A f. 1v-8v	1.4	x		1.4	x		1.4	25.5	1.071	1.1	8.4	1.467
5	c. 1321	Vesconte, Petrus	Lyons: BM, ms. 175	1.1	6.3	1.184	1.1	10.8	1.239	1.1	21.3	1.007	1.1	8.4	1.467
6	c. 1321	Anon. Venetian (Vesconte's atelier)	Vatican: BAV, ms. Vat. Lat. 2972, f. 107r-113r	1.1	x		1.1	11.5	1.163	1.3	22.5	1.127	1.1	8.5	1.449
7	1321	Vesconte, Perrino	Zurich: ZB, R. P. 4	1.0	5.0	1.356	1.0	9.5	1.280	1.0	19.1	1.021	0.9	5.9	1.708
8	c. 1325	Anon. Venetian (Perrino Vesconte's atelier)	London: BL, add. ms. 27376	1.4	7.0	1.356	1.4	11.6	1.468	1.4	28.4	0.961	1.3	8.8	1.655
9	2nd quarter 14th	Anon. Genoese	Paris: BNF, ms. Lat. 4850	1.2	6.5	1.252	1.2	11.2	1.303	1.2	22.2	1.054	1.2	8.7	1.545
10	1373-1383	Pizigano, Francesco	Milan: BA, SP 10, 29 (SP II, 2)	1.1	6.2	1.203	1.1	10.2	1.311	1.1	20.4	1.051	1.1	8.3	1.484
11	end 14th / beg. 15th	Anon. Venetian	Venice: BNM, It. VI, 213 (5982)	1.0	5.2	1.304	1.0	9.5	1.280	1.0	17.6	1.108	1.0	7.1	1.577
12	1st half 15th & c. 1434*	Anon. Venetian (poss. F. Cesanis) 'Pinelli-Walckenaer Altas'	London: BL, add. ms. 19510	1.0	5.7	1.189	1.0	9.6	1.267	1.0	18.2	1.071	1.0	6.9	1.623
13	beg. 15th	Anon. Venetian	Oxford: BodL, ms. Douce 390	1.1	6.2	1.203	1.1	11.0	1.216	1.1	20.0	1.073	1.1	7.9	1.559
14	before 1421	Anon. Venetian (attr. F. Cesanis) 'Luxoro Atlas'	Genoa: BB, SC, m. r. Cf. Ar. 2	0.7	4.2	1.130	0.7	6.2	1.373	0.6	10.0	1.170	0.7	5.4	1.452
15	1st quarter 15th	Anon. Venetian	Venice: MSN, inv. 1749	1.0	x		1.0	9.0	1.351	1.0	x		1.0	x	
16	1426 & 2nd quarter 15th**	Giroldi, Giacomo & Anon. Venetian (same atelier as Atlas no. 31)	Venice: BNM, It. VI, 212 (5694)	1.0	x		1.0	9.9	1.228	0.9	19.3	0.909	1.0	9.6	1.167
17	1430	Briaticho, Cola de	Siena: BC, SV2	0.7	4.6	1.032	0.7	6.6	1.290	1.6	27.5	1.135	0.7	4.7	1.668
18	1436	Bianco, Andrea	Venice: BNM, It. Z, 76 (4783)	1.1	x		1.1	10.3	1.299	1.4	25.2	1.083	1.1	10	1.232
19	1443	Giroldi, Giacomo	Milan: BA, SP 2, 38	0.9	x		0.9	9.0	1.216	1.0	20.6	0.947	0.9	8.2	1.229
20	1446	Giroldi, Giacomo	Florence: SC, 229 (II. II. I. 17)	1.0	x		1.0	9.7	1.254	1.3	22.6	1.122	1.0	9.0	1.244
21	c. 1446	Anon. Venetian (attr. G. Giroldi)	Milan: BA, I 96 Sup (S. P., II, 39)	1.0	x		1.0	10.0	1.216	1.3	22.7	1.117	1.0	9.3	1.204
22	c. 1446	Anon. Venetian (attr. G. Giroldi)	Chicago: NL, ms. Ayer Coll. map 2	1.0	x		1.0	10.4	1.169	1.3	22.5	1.127	1.0	9.0	1.244
23	1448	Nicolai, Nicolo	Vienna: ONB, cod. 410	1.0	x		1.0	10.0	1.216	1.0	23.3	0.837	1.0	9.3	1.204
24	2nd quarter 15th	Anon. Venetian (attr. G. Giroldi)	Vatican: BAV, Rossiano 676	1.0	x		1.0	9.2	1.322	1.0	17.6	1.108	1.0	9.0	1.244
25	2nd quarter 15th	Anon. Venetian (poss. F. Cesanis)	Florence: BML, ms. Gaddi. Rel. 9	1.0	5.3	1.279	1.0	10.0	1.216	1.6	34.0	0.918	1.0	7.1	1.577
26	2nd quarter 15th	Anon. Venetian (same atelier as Chart no. 44)	Venice: BNM, It. IV, 493 (5077)	0.7	5.7	0.833	0.7	7.7	1.105	1.1	21.4	1.002	1.0	7.2	1.556

	Date	Author / Name	Reference	Base Length of 50 *'miglia'* (in cm) for adjacent column	Measured distance of Barcelona -Marseilles (339km) (in cm)	Calculated length of 1 *'miglia'* (in km)	Base Length of 50 *'miglia'* (in cm) for adjacent column	Measured distance of Capo Spartivento - Tripoli (608km) (in cm)	Calculated length of 1 *'miglia'* (in km)	Base Length of 50 *'miglia'* (in cm) for adjacent column	Measured distance of Constanța, Romania - Trabzon, Turkey (975km)	Calculated length of 1 *'miglia'* (in km)	Base Length of 50 *'miglia'* (in cm) for adjacent column	Measured distance of Pointe Saint-Mathieu, Brittany - Calais (560km)	Calculated length of 1 *'miglia'* (in km)
27	2nd quarter 15th	Anon. Venetian (attr. G. Giroldi)	London: BL, add. ms. 18665	1.0	x		1.0	10.2	1.192	1.0	19.3	1.010	1.0	9.4	1.191
28	2nd quarter 15th	Anon. Venetian	Lyons: BM, ms. 179	1.0	5.4	1.256	1.0	9.7	1.254	0.6	10.6	1.104	1.0	6.8	1.647
29	2nd quarter 15th	Anon. Venetian (same atelier as one below)	Rovigo: BC, ms. Silv.182	1.4	7.9	1.202	1.4	12.9	1.320	1.4	24.3	1.123	1.4	9.6	1.633
30	2nd quarter 15th	Anon. Venetian (same atelier as one above)	Parma: BP, II, 32, 1624	1.4	7.8	1.217	1.4	12.9	1.320	1.4	24.0	1.138	1.4	9.6	1.633
31	2nd quarter 15th	Anon. Venetian (same atelier as Adriatic map from Atlas no. 16)	Vatican: BAV, ms. Vat. Lat. 9015	1.3	6.7	1.316	1.3	13.0	1.216	1.3	23.0	1.102	1.3	7.7	1.891
32	1462	Florino, Nicolo	Vienna: ONB, K. II. 100.725	0.7	x		0.7	6.7	1.270	0.6	12.4	0.944	0.7	5.3	1.479
33	1463	Benincasa, Gratiosus	London: BL, add. ms. 18454	1.0	5.1	1.329	1.0	9.4	1.294	1.0	19.0	1.026	1.0	8.7	1.287
34	1465	Benincasa, Gratiosus	Vicenza: BC Bert. 598b	1.3	6.7	1.316	1.3	12.0	1.317	1.3	23.7	1.070	1.3	10.5	1.387
35	1466	Benincasa, Gratiosus	Paris: BNF, Rés. Ge. DD2779	1.3	6.6	1.335	1.3	12.0	1.317	1.3	24.0	1.056	1.3	10.5	1.387
36	1467	Benincasa, Gratiosus	Paris: BNF, Rés. Ge. DD1988	1.3	6.6	1.335	1.3	12.0	1.317	1.3	24.0	1.056	1.3	10.6	1.374
37	1467	Benincasa, Gratiosus	Paris: BNF, Rés. Ge. DD6269	1.3	6.6	1.335	1.3	12.0	1.317	1.3	24.0	1.056	1.3	10.6	1.374
38	1467	Benincasa, Gratiosus	London: BL, add. ms. 11547	1.3	6.7	1.316	1.3	11.9	1.328	1.3	23.8	1.065	1.3	10.3	1.414
39	1468	Benincasa, Gratiosus	London: BL, add. ms. 6390	1.0	5.0	1.356	1.0	9.0	1.351	1.0	18.7	1.043	1.0	8.5	1.318
40	1469	Benincasa, Gratiosus	London: BL, add. ms. 31315	1.3	6.7	1.316	1.3	12.0	1.317	1.3	24.0	1.056	1.3	10.5	1.387
41	1469	Benincasa, Gratiosus	Milan: BA, S.P. 35	1.3	6.5	1.356	1.3	11.4	1.387	1.3	23.2	1.093	1.3	10.0	1.456
42	3rd quarter 15th	Anon. Venetian	Parma: BP, II, 29, 1621	1.0	5.0	1.356	1.0	9.4	1.294	1.0	19.0	1.026	1.0	8.6	1.302
					AVERAGE:	1.252		AVERAGE:	1.264		AVERAGE:	1.051		AVERAGE:	1.453
	* The atlas maps of the Adriatic and Aegean were probably written later c. 1434														
	** The atlas map of the Adriatic was by a different maker				MEDIAN:	1.292		MEDIAN:	1.280		MEDIAN:	1.056		MEDIAN:	1.452
					MINIMUM:	0.833		MINIMUM:	1.048		MINIMUM:	0.837		MINIMUM:	1.167
		OVERALL ATLAS AVERAGE:	1.255		MAXIMUM:	1.356		MAXIMUM:	1.468		MAXIMUM:	1.170		MAXIMUM:	1.891

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